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Chignik Regional Comprehensive Salmon Plan 1992–2001

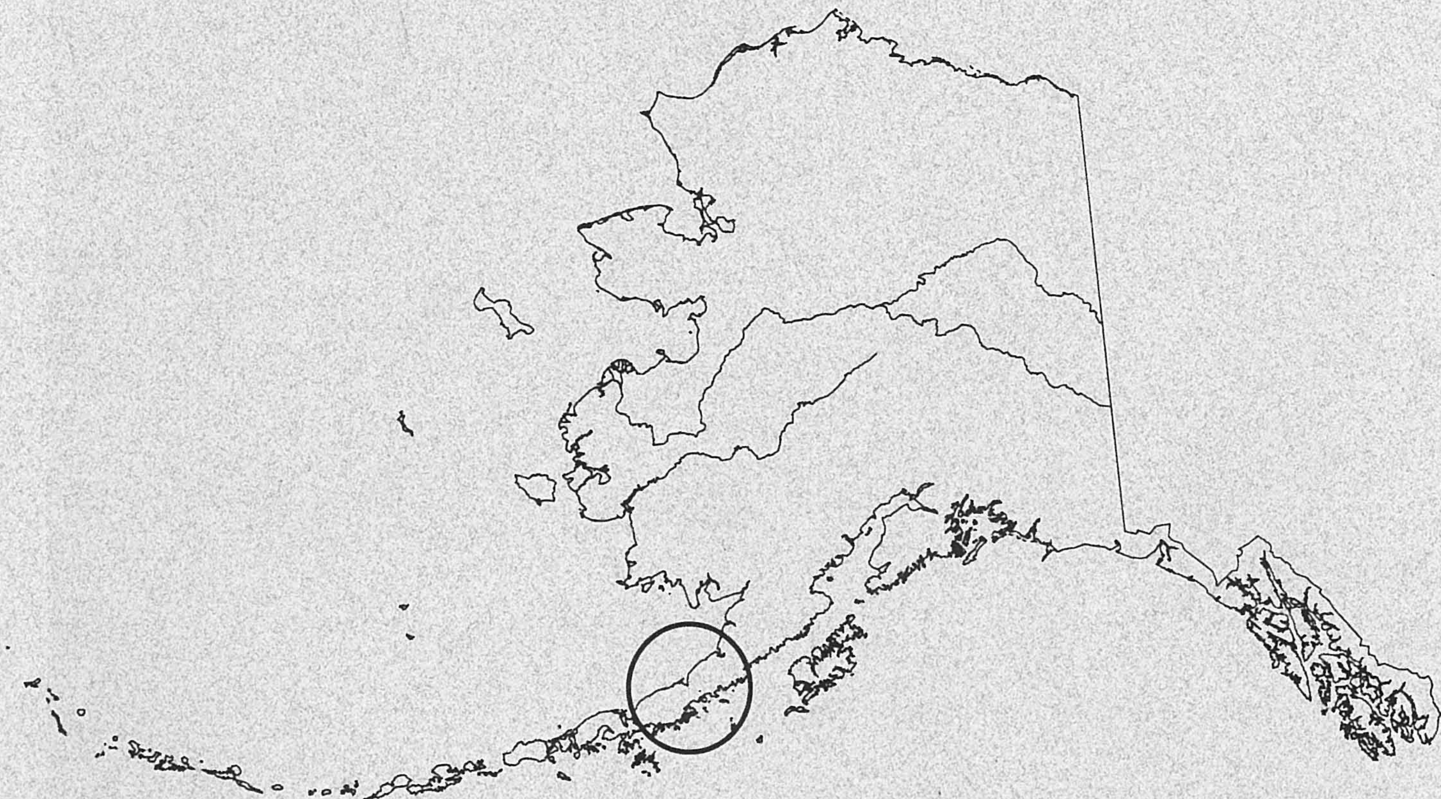
by

ADF&G Staff

June 1993

Alaska Department of Fish and Game **Division and Commercial Fisheries**

CHIGNIK REGIONAL COMPREHENSIVE SALMON PLAN
1992–2001



Developed by
Chignik Regional Planning Team

Alaska Department of Fish and Game
Carl Rosier, Commissioner
June 1993

EXECUTIVE SUMMARY

Development of a comprehensive salmon plan for the Chignik region was initiated by the Alaska Department of Fish and Game (ADF&G) in the winter of 1990 in compliance with the Commissioner's statutory mandate for salmon planning and in response to interest expressed by the Chignik Seiners Association, Chignik Regional Aquaculture Association (CRAA), local fish and game advisory committees, and seafood processors operating in Chignik Bay.

The area fishermen's objectives, as expressed by the Chignik Regional Planning Team (CRPT), emphasize improved management strategies, habitat modification and restoration, and possible enhancement of local wild stocks of sockeyes through lake fertilization. There is no clearly defined support for a large-scale hatchery production of salmon, such as those proposed by private nonprofit hatchery corporation or regional aquaculture associations in other parts of the state. There is a strong recognition of the value and need of protecting the genetic integrity Black and Chignik Lake sockeye wild stocks and a desire to promote a more comprehensive understanding of other local watersheds and their potential for increased production of sockeye, coho, chum, pink, and chinook salmon.

Specific actions promoted by this plan include the following:

Advance knowledge of salmon production in regional waters by (1) conducting comprehensive limnological surveys of Black and Chignik Lakes, (2) conducting hydraulic assessment investigations of Alec River and feasibility studies for Black Lake inlet and outlet control (3) investigating the effects of beaver colonization in the area, and (4) continuing sockeye salmon studies related to Alec River fry emigration and biology as well as smolt enumeration and sampling.

Investigate rehabilitation and enhancement opportunities by assessing area watersheds for removal of stream blockages and other barriers to fish migration.

Improve management of existing regional fisheries by (1) reevaluating escapement goals, (2) extending removal date of weir, (3) conducting stock identification studies.

The Chignik Regional Planning Team has set preliminary 10-year harvest goals that will result from existing natural production and any rehabilitation or enhancement work conducted under this plan. These harvest goals, which should be achieved by the year 2001, are listed in the table on the following page by species; the recent 10-year average harvest is also included.

10-year 1981-1990) average annual harvest and 10-year (1992-2001) target annual harvest goals for the Chignik region.

Species	Average 10-year harvest	Target harvest goal
Chinook	4,608	5,530
Sockeye	1,636,158	1,963,390
Coho	159,368	191,242
Pink	744,709	893,651
Chum	206,200	247,440

Realization of these regional harvest goals will require prudent execution of our proposed actions. In all of its efforts, the Chignik Regional Planning Team hopes this plan will initiate equitable benefits to all user groups and increase local production of salmon.

TABLE OF CONTENTS

-Continued-

-Continued-

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Authority for Writing the Plan

The Commissioner of the Alaska Department of Fish and Game (ADF&G), in accordance with Alaska Statutes 16.10.375-470, has designated salmon production regions throughout the state. In each region, the Commissioner is responsible for the development and amendment of a comprehensive salmon production plan. The Commissioner has placed this responsibility with regional planning teams (RPT) that statutorily consist of representatives from ADF&G and the regional aquaculture associations. The mission of the RPTs is to plan for the long-term future of the salmon resource within their regions by initiating and continuing an orderly process that examines the full potential of a region's salmon production capacity.

On May 14, 1990, the Commissioner established Area L boundaries as a salmon production region for comprehensive salmon planning purposes. The Chignik region includes all waters of Alaska on the south side of the Alaska Peninsula enclosed by 156° 20' 13" West longitude (the longitude on the southern entrance to Imuya Bay near Kilokak Rocks) and a line extending southeast (135°) from the tip of Kupreanof Point. Figure 1 identifies the boundaries. The Chignik Regional Planning Team (CRPT) was established by the Commissioner in July 1990. Originally, the team was composed of three representatives from ADF&G (i.e., Commercial Fish, Sport Fish, and Fisheries Rehabilitation, Enhancement and Development Divisions) and three from the Chignik Regional Aquaculture Association (CRAA). At the first meeting of the CRPT, it was decided that ex officio membership should be extended to the Lake and Peninsula Borough and to residents of Chignik Lake. The CRPT felt it was important for the borough, local native corporation (Chignik Lake River, Ltd.), and residents of Chignik Lake to be kept informed and to participate in the development of a comprehensive salmon plan for the region.

The RPT is the only legislatively mandated planning group with ADF&G and private-sector participation. Alaska statutes define certain duties of the RPT as follows: (1) plan development and amendment; (2) review of private nonprofit (PNP) hatchery permit applications/project proposals submitted by the regional aquaculture asociation and subsequent recommendations to the commissioner; and (3) review and comment on proposed permit suspensions or revocations by the commissioner (Appendix A). A regular exchange of information, discussion of objectives, and active cooperation between the association, regional planning team, and various divisions of ADF&G are possible with this planning effort .

Comprehensive salmon planning in Alaska progresses in stages. The actual plans that have been developed and approved consist of two phases: Phase I sets the goals, objectives, and strategies for the area and Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potentials of the salmon resource. However, the intent of the CRPT is to generate a regional comprehensive salmon plan that considers both the long-term goals and objectives and the short-term strategies and projects in one document.

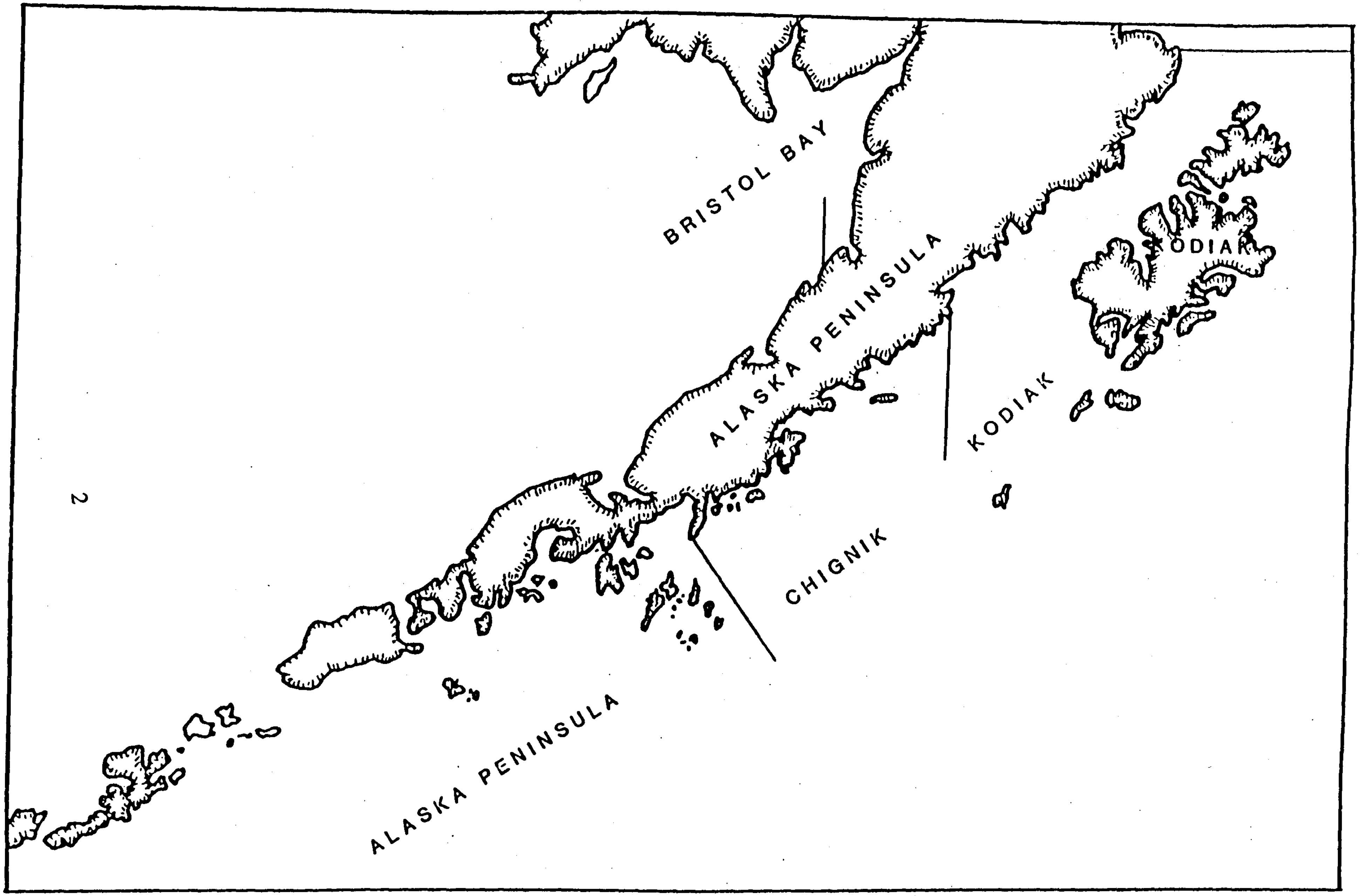


Figure 1. Map of the Alaska Peninsula illustrating the relative location of the Chignik Management Area.

Creation of the Chignik Regional Aquaculture Association

The Chignik Regional Aquaculture Association was officially approved by the Commissioner on May 14, 1990. One of the desires of the CRAA was to participate with ADF&G in planning for the long-term health of the salmon resource within the region. This determination of association status by the Commissioner was transmitted to the Department of Commerce and Economic Development in order to assist them in applying for any loans or grants available to qualified regional associations in accordance with the Fisheries Enhancement Loan Program detailed in AS 16.10.500-620.

Acknowledgments

The Chignik Regional Planning Team respectfully acknowledges its members for contributions to programs of the Department of Fish and Game, Lake and Peninsula Borough, and the people of the State of Alaska through their collective efforts in drafting the Chignik Regional Comprehensive Salmon Plan: Chairman Chuck McCallum, CSA/CRAA, Chignik; Al Anderson, CSA/CRAA/Subsistence, Chignik Lagoon; Ernest Carlson (alternate), CSA/CRAA/Processor, Chignik; Tom Kron, Regional Supervisor, ADF&G, FRED Division, Anchorage; Lola Lind, Chignik Lake Enhancement Study Team, Chignik Lake; Jim Long, CRAA/Processor, Chignik; Pete Probasco, Regional Management Biologist, ADF&G, Commercial Fisheries Division, Kodiak; Greg Ruggerone, Fisheries Research Institute, University of Washington, Seattle\Chignik Lake; Len Schwarz, ADF&G, Sport Fish Division, Kodiak; Glen Vernon, Manager, Lake and Peninsula Borough, King Salmon.

The Chignik RPT also extends its acknowledgments to Rod Cook, Chief Administrative Officer, CRAA, Edmonds; Kevin Duffy, Salmon Rehabilitation and Enhancement Coordinator, ADF&G, FRED Division, Juneau; Gary Kyle, Limnologist, ADF&G, FRED Division, Soldotna; Ole Mathisen, Professor of Fisheries, University of Alaska, Fairbanks; Sid Morgan, Planner, ADF&G, FRED Division, Juneau; David Owen, Assistant Area Biologist, ADF&G, Commercial Fisheries Division, Chignik Weir; Al Quimby, Area Biologist, ADF&G, Commercial Fisheries Division, Chignik Weir; Lisa Scarborough, Subsistence Resource Specialist, ADF&G, Subsistence Division, Anchorage; and Dana Schmidt, Chief Limnologist, ADF&G, FRED Division, Soldotna for their coordination of the planning efforts and assistance in preparing the initial and final drafts of the comprehensive salmon plan.

Chignik Questionnaire

In order to invite public participation to the comprehensive salmon planning process, the Chignik RPT drafted a 20-part questionnaire (Appendix B) to identify user needs. In May 1991 questionnaires were mailed to fishermen holding limited-entry seine permits, local and regional native corporation offices, community leaders, representatives of fish processors in the region, legislative representatives, staff from Lake and Peninsula Borough, as well as staffs from other interested state and federal agencies. This questionnaire provided the Chignik RPT with valuable information for long-range planning that have been incorporated into this plan.

Planning Assumptions

An important component of the planning process is the adoption of key assumptions. During development of the comprehensive salmon plan for the Chignik region these assumptions are essential to the accurate understanding and implementation of goals:

1. It is the primary consideration to protect wild stock species of salmon and maintain their historic levels of productivity; protection of wild stocks is inseparable from their use in commercial, subsistence, and recreational fisheries as well as the carrying capacity of their habitat;

2. It is biologically feasible to bring about a sustained increase in the harvest rates of salmon beyond the past 10-year (1981-1990) average, if appropriate technological and managerial practices are used;

3. The goals and objectives of the plan will be reviewed and revised as needs, knowledge, and resources require;

4. Research programs will be implemented to obtain information for optimizing salmon production and to determine whether management, habitat protection, enhancement, or rehabilitation measures will be needed;

5. Political support will continue, and sufficient funding will be provided to achieve the goals in a timely manner; and

6. Close cooperation between those involved in the planning and implementing processes (i.e., state agencies and representatives of commercial fishing and processing interests) will continue so that the maximal sustainable harvests of salmon can be achieved.

7. The intent of this plan is to identify projects that will provide additional salmon to all common-property users within the region without further complicating the allocations of salmon outside the region.

CRPT Policy for Evaluating Habitat Modification Projects

Based on the planning assumptions contained herein (i.e., Chignik Regional Comprehensive Salmon Plan) and the interests and concerns of the users of the salmon resource of the Chignik management area, CRPT endorsement of rehabilitation or enhancement project proposals requiring significant habitat modifications will be evaluated in the following manner. Of the highest priority are the safety, security, rehabilitation, and enhancement of the salmon resource. Adequate scientific research and peer review concerning potential negative impacts of each and every habitat modification proposal shall be accomplished before any habitat modification is carried out. The preponderance of scientific opinion shall be that no negative impacts on the salmon resource will occur as a result of any habitat modification proposal before CRPT will recommend approval of the project. The highest scientific standards will be applied to prevent negative habitat impacts before projects are initiated, although CRPT is willing to allow for a somewhat greater risk that a project may fail to meet its enhancement or rehabilitation goals, provided the chances of negatively impacting the habitat or salmon stocks are minimized. Where the risk does not include damage to the habitat, but simply a potential failure of a project to either rehabilitate or enhance a salmon run, then that risk is essentially a financial one borne primarily by CRAA. Where there is a reasonable scientific reason for believing that the proposed habitat modification, rehabilitation, or enhancement project will be a success, then CRPT may, at its discretion, choose to recommend the implementation of that project. Each project, however, will be evaluated within a specified period of time to determine whether it has been successful. If the success of the project does not fall within stated enhancement parameters (i.e., performance standards), provisions shall be made for the return of the manipulated and/or affected habitat to preproject conditions. Such corrective actions, if needed, shall be completed within a specified period of time after the decision has been made by CRPT that the habitat manipulation failed to meet the stipulated goals.

Planning Period

While the Chignik Regional Planning Team has selected a 10-year period (1992-2001) for realizing targeted annual harvest goals set out in this plan, it has focused on a 5-year planning period (1992-1996, see 5-Year Action Plan, page 63) to enable them to acquire the necessary baseline database for implementation of larger enhancement or rehabilitation projects (e.g., stabilization of Black Lake or water control diversion of Alec River) as well as implement smaller projects (e.g., stream clearance, lake fertilization, etc.). It was further agreed that at the end of the 5-year period, they might have a better indication on the status of fish prices and demand in the market place, so they could more constructively prepare long-range strategies.

REGIONAL PROFILE

Physical Environment

The Chignik region encompasses all coastal waters and inland drainages of the northwest Gulf of Alaska between Kilokak Rocks and Kupreanof Point (Figure 2). The area includes the Chignik River system and approximately 100 other salmon producing streams. The Aleutian Range, which runs the length of the Alaska Peninsula, is a dominant influence on the region, providing a natural barrier to weather systems and creating two distinct climatic zones. On the Pacific side of the peninsula, the Aleutian Range meets the water abruptly at the sea in rugged cliffs and a number of offshore rocks and islands. Several large bays protected coves are found along the Pacific coastline. Within the Chignik area the lowlands are extremely narrow and limited, with mountains rising directly from the ocean in many places; however, on the Bering Sea side of the Alaska Peninsula, the Aleutian Range gradually slopes toward the Bristol Bay coastal plain.

The entire Alaska Peninsula is an area of considerable volcanic and tectonic activity because the Pacific Plate subducts beneath the North American Plate along the Aleutian Trench, making it part of the "ring of fire" surrounding the Pacific Basin. There are 11 active volcanos within 300 miles of the community of Chignik Bay, including Mount Veniaminof 40 miles to the west. Because smaller earthquakes (i.e., less than 5.0 on the Richter Scale) commonly occur, all structures (e.g., hatchery facility) must be designed to withstand them. Because the Chignik region is within the Shumagin Islands Seismic Gap, it must be considered a high-risk seismic zone, and it is possible that a great earthquake (i.e., greater than 7.0) will occur there.

Communities:

Chignik. The name Chignik is an Aleut word meaning "wind" (Alaska Department of Community & Regional Affairs 1982). Located in Anchorage Bay on the southern shore of the Alaska Peninsula, Chignik City is the oldest continuously occupied community in the region; since 1889 it has been a center for commercial fish processing. It is accessible by air and water; it has the most reliable and frequent marine services (barges and ferries) in the region, and a 4-mile road system provides access to the airfields and scattered residential areas; the climate is typically maritime. Similar to other communities in the region, fishing and fish processing (i.e., Chignik Pride & Aleutians Dragon seafood processing plants) provide the basis for the economy. The summer population of Chignik increases by 500 fishermen/fish processor workers during the season. Beginning in early June local fishermen began preparing to fish for sockeyes (Chignik and Black Lake runs); following these two major runs, they focus on successive runs of pinks, chums, and cohos.

About 50% of Chignik residents are Alaska Native; and according to the provisions of the Alaska Native Claims Settlement Act (ANCSA) of 1971, Chignik's native corporation (Far West, Inc.) is entitled to select 115,200 acres of land. There is also a good deal of privately patented land along the shores of Anchorage Bay. Excluding fish processing facilities,

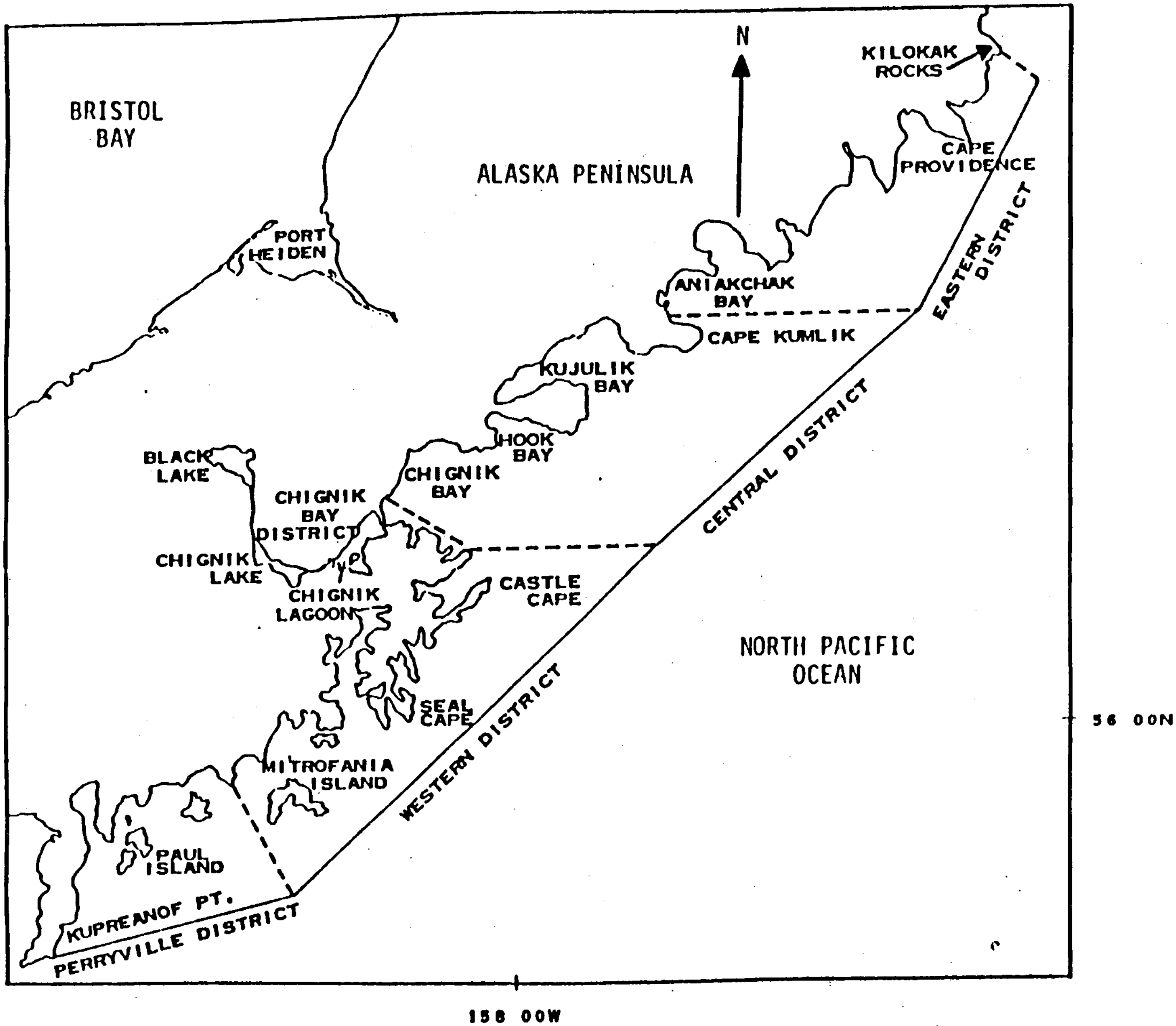


Figure 2. Map of the Chignik Management Area illustrating district boundaries.

employers in the community include the school, U.S. Post Office, state (airport maintenance), Bristol Bay Health Corporation, Chignik General Store, the village council, and a local restaurant.

The relationship of people in the community is characterized by a changing seasonal population, with contrasts occurring especially between the summer and winter residents (Davis 1986), a long history with local processing facilities (i.e., "canneries"), and extensive ties to Kodiak Island. Within the last decade Chignik has also become incorporated as a second class city. Economically, there has been changes in the number and types of local jobs and salmon prices have fluctuated dramatically. Commercial fishermen depend on their limited entry permits, and in the community their distribution is particularly significant (Davis 1986).

Chignik Lake. Located on the Alaska Peninsula 265 miles southwest of Kodiak or 665 air miles from Anchorage via King salmon, Chignik Lake is a predominately Aleut community (i.e., 95%) that has taken its name from the lake on whose shore it is built. The largest permanent winter village in the Chignik region it is a relatively new community established in the late 1950s. The eventual transformation of this community from a camp to a permanent winter village was related to the establishment of a school and a church. In the spring of 1985, a total of 160 residents lived in 34 households (Davis 1986).

The village is an unincorporated community within the Lake and Peninsula Borough. It is built on a Bureau of Land Management federal townsite and state municipal trust lands. Most of the lots within the survey plat have been conveyed to their occupants. Land surrounding the community is owned by Chignik River, Ltd., which is the village native corporation established under ANCSA; and most of the Alaska Native residents of the village are also shareholders in that corporation.

Chignik Lake is only accessible by air and to a limited extent by water; there are no roads connecting it to the nearby communities. Peninsula Airways and Markair provide scheduled mail and passenger service as weather permits. There is one main road and several trails through the village, and the state maintains a 3,200-foot gravel runway. Commercial fishing is the mainstay of the local economy, and many residents move to fish camps at Chignik Lagoon or to Chignik Bay for employment during the summer months. In 1982 there were eleven limited entry permit holders in the village (Davis 1986); however, in 1992 there were only five because three permit holders moved and three sold their permits (Lola Lind, personal communication). The majority of remaining adult males in the community work as crew members for either permit holders from the village or other communities in the region. Most other jobs in the village are in community service. The school employs five teachers, four teacher's aides, one janitor, a cook, and a secretary. There is a U.S. Post Office employee, a state employee to maintain the runway, and a health aide position. The village council usually employs between 10 and 15 individuals each month in permanent and part-time positions (ADCRA 1982). For the ten-year period 1973 to 1984, the Community Hall was built, village telephones installed, water and sewer system established, television services provided, gymnasium built, fire truck purchased, new school built, and Alascom satellite station established.

Chignik Lagoon. There are really two communities at Chignik Lagoon, which is an expanse of water about 7.5 miles long and 2.5 miles wide that is connected to Chignik Bay by a narrow channel at its northwestern end: one is the Chignik Lagoon on the "flat side," and the other is the one on the "cannery side." The one on the flat side is a permanent year-round community on the southwest shore of the lagoon, located approximately 5.5 miles west of Chignik and 11 miles downriver from Chignik Lake. It has a permanent winter population of about 80 people, increasing by about 40 households (i.e., effectively tripling the population) in the summer. The cannery-side community is two miles away on the opposite or east shore of the lagoon and is formed only during the summer by residents of Chignik Lake and Perryville. Distinctions between the two groups involve established cultural patterns with a history of ethnic and religious differences that have continuing social implications (Davis 1986).

Chignik Lagoon on the flat side is a center for commercial fishing and for small, local businesses--many of which have been recently established. In 1985 there were 12 limited entry permit holders there who also owned their own boats (Davis 1986). Most males without permits rely on working as crew members for those fishermen having permits for their livelihoods. Other jobs available in the community are in the school, light plant, post office, television maintenance, air strip maintenance, health clinic, community hall, garbage collection, health aide, village council, heavy equipment operation, and carpentry. Access is limited to air and water, and there are no roads connecting it to the other nearby communities. Peninsula Airways, based in King Salmon, conducts a regularly scheduled (weather permitting) mail and passenger service at the 1,700-foot runway. There are approximately one mile of local roads that are maintained by residents under contracts to the village council. A barge line also provides annual shipping services to the community. Under the provisions of ANCSA, the Chignik Lagoon Native Corporation is entitled to select 94,080 acres of land from the federal government.

Ivanof Bay. Located on the northeast end of the Kupreanof Peninsula and accessible by only by air and water, Ivanof Bay is the newest, smallest, and most westerly community of the region. In 1965, six families united by a common religious commitment to the Slavic Gospel Mission moved from Perryville, where the majority of villagers were members of the Russian Orthodox Church, to an abandoned cannery site at the protected end of Ivanof Bay about ten miles away (Davis 1986); the cannery had been operational in the 1930s, 1940s, and early 1950s. Although Davis (1986) placed the 1985 population at 51, according to the 1990 U.S. census it had dropped to 35. Davis (1986) also indicated that the community had its own particular combination of economic activities that involved harvesting subsistence resources, purchasing available store goods, and distributing money earned from commercial fishing and local jobs, noting that two limited entry permits were held locally. Other than fishing-related employment, jobs in the community include two part-time positions at the Ivanof Bay General Store, a health aide, school teacher, school maintenance person, and part-time work with the phone system. Most families move either to Chignik City or Chignik Lagoon for the summer salmon fishing activities, returning in August.

Under ANCSA the local Bay View Native Corporation is entitled to a land selection of 81,502 acres. By location and social networks, the people of Ivanof Bay are linked to Sand Point to the west and Chignik Lake and Chignik Bay to the east. Their social ties to nearby Perryville are not as strong, although Perryville residents use the Ivanof Bay store. The community can be characterized as a small, kinship-based village that wishes to maintain both a strong religious orientation and a sense of privacy.

Although there is no deep-water harbor or public dock, Ivanof Bay is primarily accessible by boat as well as commercial air taxis from King Salmon or Sand Point. There are no roads connecting it to other communities, and boardwalks have been installed to make it easier to move around the community during spring breakup. Three-wheel, all-terrain vehicles are commonly used for local travel, and skiffs are used for transport to nearby Perryville. There is a 1,200-foot runway that accommodates single-engine and light twin-engine aircraft.

Perryville. Located 40 miles southwest of Chignik and 68 miles east of Sand Point, Perryville is the second-oldest community in the Chignik region. It is situated on a shallow and extensive beach of black sand on the Kametolook River delta at the foot of Mount Veniaminof. Its residents are descendants of families from the villages of Katmai and Douglas that where abandoned following the 1912 eruption of Mount Katmai (Davis 1986).

The village economy centers around commercial fishing/processing; in 1985 seven limited entry permits were held by local residents. When the fishing season begins in early June, a substantial portion of the community moves to either Chignik Bay or Chignik Lagoon. Other jobs include a U.S. Post Office employee; health aide; two part-time telephone operators; an airport maintenance person; a maintenance person for the community generator, water treatment plant and roads; village clerk; 4 school teachers; principal; school janitor; school cook; and part-time work at the community store. Construction projects also occasionally provide seasonal employment. According to the provisions of ANCSA the Oceanside Native Corporation is entitled to select 92,160 acres of land (ADCRA 1982).

Perryville is accessible by water and air; there are no roads connecting it to other villages, although there is about two miles of local roads maintained by local residents. Foot trails interconnect the community, and three-wheelers, pick-ups, and small skiffs are common modes of local transportation. There is a 1,800-foot gravel runway that accommodates single- and light twin-engine aircraft; however it is in poor condition because it follows a beach ridge that is soft, sandy, and pitted with ruts. A planned realignment would increase the length to 1,950 feet. A barge line delivers supplies to the community on an annual basis. Because there is no public dock or harbor, all supplies must be lightered to shore and fishing boats harbored at Chignik Bay or Chignik Lagoon.

Water Resources:

The Chignik River (draining Black and Chignik Lakes) and the Clarks and Kametolook Rivers (draining the snowfields of Mount Veniaminof are the 3 major river and/or lake systems for the Pacific side of the Alaska Peninsula. Several other rivers and lakes, streams, ponds, wetlands, coastal bays, ports, tidal flats, and harbors are found throughout the region.

Climate:

The Chignik region is partly protected from the most severe southerly Pacific storms by a ridge of mountains rising to 3,000 feet. Frequent cyclonic storms crossing the northern Pacific and the Bering Sea are the predominant weather factors. These storms account for the frequent high winds and the common occurrence of fog and low visibility. Fog occurs most often from mid-July to mid-September. The Chignik region has a maritime climate characterized by cool summers, relatively warm winters, and rainy weather. The mean daily temperature ranges from about 40° to 60° F in the summer and from approximately 20° to 40° F during the winter; the highest recorded temperature was 76° F and the lowest -12° F.

Thick cloud cover and heavy winds limit travel to and from Chignik and the surrounding region, especially in the winter, when the region experiences from 35 to 45 days of adverse weather and rough seas. In summer, approximately 15 to 20 days are affected by storms. Total precipitation averages 130 inches annually; average snowfall is 60 inches. The average wind speed at Chignik is estimated at 10 miles per hour. Residents say winds generally blow from the northwest, but the direction often changes quickly. Sudden violent gusts of cold air called williwaws are common. Tides in the area range from a mean high-water level of approximately +8.9 feet to an extreme low-water level of -4.0 feet; the mean is 4.8 feet. High-water levels caused by offshore storms occur each year.

Vegetation:

Vegetation along the ridge tops is relatively barren because of the harsh environment of broken rock and steep topography. At lower elevation, the vegetation is predominantly alder-willow scrub with a dense understory of bluejoint grass and a mixture of herbs. Along the shore line and in the lowlands there is beach fringe and wetland vegetation.

Wildlife:

Brown bears are common throughout the region and are often seen in and about Chignik Bay, congregating in the summer and fall around salmon spawning streams. Although moose and caribou occur in the area, their numbers are not abundant. Other terrestrial mammals common to the area include wolverines, wolves, lynx, beavers, river otters, mink, weasels, foxes, porcupines, and arctic hares. Marine mammals found in the coastal waters include harbor seals, sea lions, gray and beluga whales, walruses, and sea otters. The peninsula also provides abundant habitat for millions of birds, particularly pelagic birds, waterfowl, and shorebirds.

Much of the waterfowl, such as dabbling ducks, diving ducks, and geese use the region as a staging area to and from their nesting grounds farther north; swans also nest in the area. Warm ocean currents and ice-free waters encourage some waterfowl and shorebirds to winter along the coast.

Fish:

Salmon are the dominant fish species harvested in the area by all user groups. Virtually all of the Chignik Bay District (i.e., those waters southwest of a line extending from Jack Point on the south to Neketa Creek on the north) harvest is generated by the highly productive Chignik River system. Species include sockeye, coho, pink, chum, and chinook salmon (Table 1). Other important finfish species include halibut, walleye pollock, Pacific cod, sablefish, arrowtooth flounder, herring, and Dolly Varden char. Nursery areas for many of the bottom fish are located in the estuaries, bays, and near-shore waters; as these juvenile fish develop they move to progressively deeper areas of the continental shelf before finally merging with the adult populations. Important shellfish species include king, tanner, and dungeness crabs; shrimps; clams; and scallops.

Human Environment

History:

Six thousand years before the arrival of European explorers in 1741 (i.e., Vitus Bering and Aleksei Chirikof), the Pacific shore of the Alaska Peninsula was inhabited primarily by Aleuts and Pacific Eskimos, who were maritime hunters that relied heavily on the marine mammals and fish for food, oil, and clothing needs. They were extremely adept at using ocean-going craft (e.g., bidarkies and unimaks), relying on raincoats made from the intestines of whales, seals, or sea lions to keep themselves warm and dry.

Between 1741 and 1784 Russian exploration in Alaska was sporadic. Instead, much of the exploring and mapping was conducted by non-Russians; e.g., James Cook, John Mears, and Nathaniel Portlock. In 1784 Gregorii Ivanavich Shelikov established a colony at Three Saints Bay on Kodiak Island, resulting in the establishment of a series of trading posts (related to the fur trade). In 1790 the first serious attempt to explore the Alaska Peninsula was undertaken by Dimitri Bocharov, who travelled up the Bering Sea coastline as far as the Kvichak River.

Although the United States purchased Alaska from Russia in 1867, a USGS survey of the southern coast of the Alaska Peninsula was not conducted until 1895 by George Becker and William Dall. When the American government assumed political control, commercial activities continued along the same lines as those established by the Russians (e.g., whaling, trapping). The major factor changing the patterns of life in the region was the introduction of commercial fishing. Chignik was established as a fishing village in 1888 when the Fisherman's Packing Company of Astoria, Oregon packed 2,160 barrels of salted salmon. In 1889 this same company built a cannery in Chignik Lagoon, and two more had been built in the area by 1893. From that

Table 1. Life cycles of salmon species in the Chignik area drainages.

Lifestage	Activity	Chinook	Coho	Sockeye	Pink	Chum
Egg	Incubation location	clean gravel riffle	small streams; clean gravel	streams near lakes; springs	clean gravel, intertidal,lower stream	intertidal lower stream
Alevin	Hatching (remain in gravel)	midwinter	late winter	mid/late winter	midwinter	midwinter
	Emergence (swim-up)	April-May	May-June	April-May	April-May to estuary	April-May to estuary
Fry	Rearing location	stream, river edges	lakes, streams, ponds, sloughs	mostly lakes; some sloughs	nearshore, marine	nearshore, marine
	Time in fresh water	1 year	1-2 years	1-2 years	short-term	short-term
	Food	aquatic insects plankton	aquatic insects plankton	plankton	plankton	plankton
Smolt	Migration	May-June	June-July	May-June	May-June (as fry)	May-June (as fry)
	Size	3-4 inches	4 (+) inches	3 (+) inches	1.5 inches	1.5-2.0 inches
	Age	1 year	1-3 years	1 or 2 years	1-3 weeks	1-6 weeks
Ocean rearing & development	Food	fish/other	fish/other	large plankton	fish/other	fish/other
	Growth	rapid	rapid	rapid	rapid	rapid
	Time in ocean	1-5 years	1 year	2-4 years	1 year	2-4 years
Homing Migration	Timing	June-July	August-October	June-October	July-August	July-September
	Average weight	22.7 pounds	8.5 pounds	6.8 pounds	3.8 pounds	7.1 pounds
Spawning	Timing	July-August	September-October	June-January	July-August	July-September
	Location	streams, rivers	streams	streams, near lakes lake upwelling, sloughs	intertidal; lower stream	intertidal; lower streams, sloughs

point onward, commercial fishing has been the dominant influence there. Many of the values and the regional economy have developed as a result of the dominance of the commercial fisheries.

In the early processing days the canneries owned the boats and gear and operated the traps. Increased opportunities for the involvement of local residents into commercial fishing and processing industries occurred during the 1940s (World War II); however, since that time the relationships between fishermen and processors have gradually evolved from one where the canneries provided and controlled just about all facets of the fishery to a more balanced one of cooperation and equality, with independent fishermen owning their own boats. Although many changes continued to occur and are occurring in the region, subsistence fishing, hunting, and gathering activities have remained an important component for residents there. Table 2 provides a brief outline of the historical events occurring on the Peninsula.

Population Characteristics:

Alaska Natives, who identify themselves as primarily Aleuts, compose the majority of the residents of each community in the region. In most instances the non-Alaska Native residents have settled into the area through marriage to residents of one of the communities. The greatest number of nonmarriage-related or non-Alaska Native residents are usually in those communities having active land-based processing operations; e.g., Chignik Bay. Major social criteria of the communities are related to the importance of family and kinship, identification with Native issues, and participation in commercial fishing. Kinship commonly ties households and families within and between communities. The working groups for both commercial and subsistence activities are generally established along these family and kinship networks. According to the 1990 U.S. Census, there was a total population of 517 in the 5 communities of the region (U.S. Dept. of Commerce 1990): Chignik City = 188; Chignik Lake = 133; Chignik Lagoon = 53; Perryville = 108; and Ivanof = 35.

Economy:

Commercial salmon fishing is the single, most important cash-producing activity for Alaska Peninsula residents, although other fish species, such as halibut and crab, are also commercially sought. Lack of wage earning opportunities outside of commercial fishing and related activities is prevalent in communities throughout the region. Table 3 shows the average annual earnings from the salmon fishery between 1975 and 1983 for all the Chignik communities except Ivanof Bay (Langdon 1985). By comparison, respondents to the Chignik Questionnaire for Comprehensive Salmon Planning indicated they needed an average annual gross income of $300,000 to pay for their annual fishing and living expenses. Employment other than those jobs related to fishing is dominated by seasonal and part-time positions, many of these provided by local, state, and federal agencies (e.g., village and city councils, school district, Department of Transportation, U.S. Post Office, etc.). Much of the local employment opportunities are limited to unskilled labor; for example, construction projects, janitorial services, etc. Although skilled laborers sporadically find work, opportunities generally depend on the amount of contract work

Table 2. Significant historical events occurring on the Alaska Peninsula.

Date	Historical event
1741	Vitus Bering and Aleksei Chirikof land in Alaska
1804	Russian-American Company establishes trading posts at Katmai Village and Sutwik Island
1867	United States purchases Alaska from Russia
1888	Salmon saltery is established at Chignik Bay
1903	Oil drilling begins at Puale Bay
1912	Novarupta erupts, forcing residents of villages of Katmai and Douglas to relocate and establish new village at Perryville
1918	Katmai National Monument is established
1922	Oil drilling is resumed at Puale Bay, and Kanatak becomes a boom town
1923	Russian Orthodox church is built at Perryville using icons from Katmai and Douglas
1940-1945	Scarcity of labor by 2nd World War results in opportunities for Alaska Native residents to participate in commercial fisheries
1949	School teachers establish Slavic Gospel Mission in Chignik
1950	Perryville organizes under IRA charter
1959	Alaska becomes 49th state, and fish traps are prohibited
1960	The community of Chignik Lake begins as residents remain year-round at the seasonal trading camp
1965	Families from Perryville establish new village at Ivanof Bay
1971	The Alaska Native Claims Settlement is passed

-Continued-

Table 2. Continued

Date	Historical Event
1975	Limited entry to commercial salmon fisheries in Alaska is established
1978	U.S. Secretary of Interior withdraws 110 million acres of land throughout Alaska, including 4.3 million acres for the Alaska Peninsula Wildlife Refuge, 1.2 million acres for Becharof Wildlife Refuge, 0.35 million acres for Aniakchak National Monument, and an additional 1.4 million acres for expansion of Katmai National Monument
1980	Alaska National Interest Lands Conservation Act (ANILCA) is passed: Alaska Peninsula and Becharof Wildlife Refuges designated, Katmai National Monument redesignated as Katmai National Park and Preserve, and Aniakchak National Monument and Preserve increased by 0.16 million acres. Rural subsistence hunting and fishing established as the priority use of fish and wildlife resources on federal lands
1989	An 11 million gallon oil spill of the tanker Exxon Valdez in Prince William Sound causes cancellation or curtailment of most salmon fisheries in Chignik region; i.e., fishing confined to Chignik Lagoon
1990	Alaska's subsistence laws overturned by the Alaska Supreme Court. Federal government stepped in to assume management of all fish and game on federal lands (i.e.,approximately 60% of state)

Table 3. Per capita annual gross earnings (in thousands of dollars) from the salmon fisheries of the communities of the Chignik region, 1975-1983.

Year	Chignik Bay	Chignik Lake	Chignik Lagoon	Perryville
1975	19.0	20.6	31.3	19.7
1976	54.9	62.4	75.7	62.4
1977	155.0	141.5	186.5	169.2
1978	106.8	145.6	169.0	197.8
1979	97.2	115.1	149.7	166.7
1980	56.9	51.4	78.1	73.9
1981	157.4	133.1	219.7	164.8
1982	106.4	99.1	195.9	131.9
1983	86.0	85.2	122.2	131.8

associated with grants or schools. Self-employment opportunities are found in family retail stores, rental units, video (movie) rentals and video game machines, and other miscellaneous cottage crafts. In Chignik Bay, where two land-based processing plants are located, residents are less dependent on fishing for cash incomes because many of the residents are employed by the cannery. Table 4 shows the relative number of households in the various communities that participate in nonfishing wage employment (Morris 1987).

Land Status and Use:

The Chignik region is flanked to the northeast by the Becharof National Wildlife Refuge, and with the exception of a scattering of private or selected (i.e., patent, state, or Native) lands, the majority of the land has been incorporated into either the Alaska Peninsula Wildlife Refuge or the Aniakchak National Monument and Preserve (Fig. 3). In 1984 a plan was cooperatively developed for the Bristol Bay area, including the Alaska Peninsula, to address land usage and development (DNR et al. 1984). The principal use of these lands was determined to be the harvest of fish and wildlife; i.e., commercial fishing, sport fishing and hunting, and subsistence activities. Two goals were established to protect the fish resources: (1) to maintain historic levels of fish productivity as well as the carrying capacities of their habitats and (2) to provide optimal use of fish resources through conservation and compatible management of land use.

To assure the maintenance of existing fish population levels in the region, navigable waters within Becharof and Alaska Peninsula wildlife refuges were closed to mineral entry. Surface entry for oil and gas exploration development in the Black and Chignik Lakes and Chignik River and coal development within one mile of Black Lake and any active salmon spawning stream bed in the Chignik area were prohibited. Except for public water supply and domestic use, the maintenance of fish stocks is the highest priority use of water in the region. To minimize negative impacts on water quality and public access, where possible the state will retain a strip of land or buffer adjacent to fish habitat; private owners are also encouraged to maintain such

Table 4. Number and percentage of households ($\underline{N}^{a}$) participating in nonfishing wage employment in the communities of the Chignik region, 1986.

Chignik Bay ($\underline{N}$ = 19)	Chignik Lake ($\underline{N}$ =23)	Chignik Lagoon ($\underline{N}$ = 17)	Ivanof Bay ($\underline{N}$ = 6)	Perryville ($\underline{N}$ = 20)
13 (60%)	11 (48%)	9 (53%)	2 (33%)	10 (50%)

[a] No. of households surveyed in each community.

buffers. Development of lands adjacent to fish habitat will be limited to those that do not significantly alter the natural stream course or channel, and the extraction of sand, gravel, and minerals from fish habitat will be avoided.

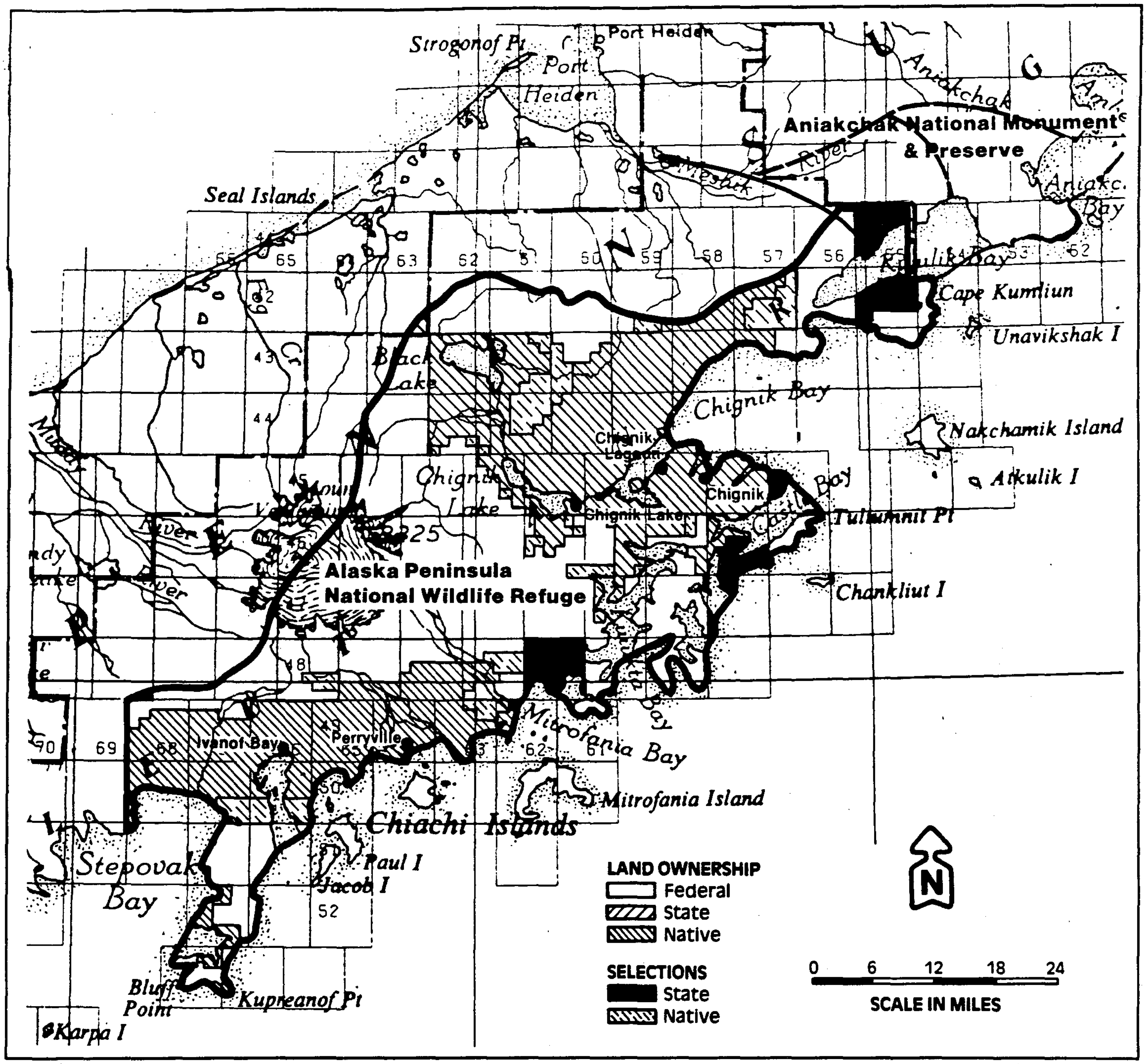


Figure 3. Land ownership and usage in the Chignik region (source: DNR et al. 1984).

REGIONAL FISHERIES

Subsistence Fisheries

Salmon has been and continues to be the most important subsistence resource on the Alaska Peninsula. Methods of harvesting salmon in historic times focused chiefly on fishing in streams, rather than in the bays; these methods generally included weirs, spears, and traps. The two main factors distinguishing current harvest methods with those of the past are almost exclusive use of gillnets in saltwater bays. Although many people in the region's communities fish for salmon on a small scale, a few devote substantial time and effort, and those who fish most intensively often work cooperatively with others. The primary expenditures for subsistence salmon fishing are a boat, motor, fuel, and gillnets; however, because of the expense of gillnets (i.e., approximately $1,000 or more for a new one) old commercial nets are most often cut down and used. While many local residents participate in the subsistence fisheries, virtually everyone in all the communities use salmon; the primary methods of preserving them include salting, drying, smoking, freezing, and canning.

Halibut and cod are the primary open sea fish resources for the region's residents, and their importance goes back to precontact times. They represent a single subsistence activity, because both fish are caught in the same places using the same methods. Fishing is done from skiffs with hand lines, fishing poles, or halibut skates. In addition to salmon, halibut, and cod, many other finfish species are utilized; foremost among these are Dolly Varden char, rainbow trout, herring, sea bass, pollack, and flounder. Marine invertebrates used include sea urchins, clams, chitons, mussels, crabs, and shrimp. Generally, subsistence harvests in the region have been underreported, the RPT does not perceive any conflict during the initial 5-year period covered in the plan, the area is remote and nearly inaccessible from incursion by recreationists, and therefore no reasons exist for the demand for subsistence fishing to increase in the region.

Sport Fisheries

The Chignik River supports annual returns of all 5 species of salmon. Within the past several years, local residents have expressed concern about the status of the chinook salmon stocks returning to the river. The stocks are harvested incidentally in the primary commercial fishery that is directed at sockeye salmon as well as in the sport and subsistence fisheries. Beginning in late May and continuing until late August, escapements of chinook salmon are monitored at a weir on the Chignik River midway between Chignik Lagoon and Chignik Lake. The 10-year (1981-1990) average escapement of chinook salmon into the Chignik River is 3,369 (Table 5); the average commercial harvest for the same 10-year period is 4,608.

The sport fishing effort and harvest have been variable, and they are often based on the amount of commercial fishing time, because many of the sport fishermen are also associated with the commercial fishing industry. Programs designed to accurately estimate the harvest of chinook salmon have only been conducted in 1988 and 1989 (Murray 1988, Schwarz 1990). The sport harvests during those years were 233 and 181 chinook salmon, respectively. The respective

Table 5. Estimated Chignik River chinook salmon returns, 1963-1990.

Year	Escapement[a]	Harvest	Total Run[b]
1963	564	1,744	2,308
1964	914	1,099	2,013
1965	942	1,592	2,534
1966	822	636	1,458
1967	1,500	882	2,382
1968	1,000	674	1,674
1969	600	3,448	4,048
1970	2,500	1,225	3,725
1971	2,000	2,010	4,010
1972	1,500	464	1,964
1973	822	525	1,347
1974	672	255	927
1975	877	549	1,426
1976	700	763	1,463
1977	798	711	1,509
1978	1,197	1,603	2,800
1979	1,050	1,266	2,316
1980	876	2,325	3,201
1981	1,603	2,694	4,297
1982	2,412	5,236	7,648
1983	1,943	5,488	7,431
1984	5,806	4,318	10,124
1985	3,144	1,919	5,063
1986	3,612	3,037	6,649
1987	2,624	2,651	5,275
1988	4,868	7,296[c]	12,164
1989	3,316	3,542[c]	6,858
1990	4,364	9,901	14,265
1981-90 avg	3,369	4,608	7,977

[a] no chinook escapement estimate after weir removal.

[b] estimates are conservative because of difficulty in distinguishing small chinook from sockeyes at the weir.

[c] excludes sport fish harvest estimates for 1988 and 1989 of 233 and 181 chinook salmon, respectively.

commercial harvests for those 2 years were 7,296 and 3,542, and escapements were 6,091 and 3,888. Although a creel survey was not conducted in 1990, the commercial harvest of 9,901 and an escapement of 4,364 indicates that a sport fishing harvest in the neighborhood of 200 to 300 chinook salmon will not damage the stock. The return over the last 10 years (1980-89) has averaged 7,620. Of the various fisheries harvesting these stocks, the commercial fishery is the primary user. The sport fishing effort for chinook salmon (Table 6) occurs primarily in the area of the river between the outlet of Chignik Lake and the weir, because this is where they hold up while they are becoming sexually mature. Although the sport fishery harvests make up only a small portion of the return (2% in 1988 and 1989), there is a general perception among local residents that these harvests have increased in recent years. A summary of demographic data collected in conjunction with the creels survey is provided in Table 7. These data indicate (1) a majority of sport anglers in the Chignik River chinook fishery were unguided adult residents of the state, (2) most anglers used spinners, and (3) the bulk of harvest occurred above the weir. Six-, five-, and four-year-old chinook salmon accounted for 44%, 43%, and 10% of the sport harvest in 1989, respectively. The proportion of male to females was nearly even at 47% and 53%, respectively. In the dominant age class (i.e., 6 years of age = 1.4), the length of the males and females averaged about 35 inches (905 and 889 mm, respectively).

Although there are a number of guiding operations out of King Salmon and Kodiak that bring sport fishermen into the Chignik area to fish, their impact on the sport fisheries is minimal and has not yet been quantified. Regional staff of the Sport Fish Division are planning to investigate the status and impacts of this new sport fish industry. Sport fishing efforts have increased in the outlying districts, most notably Main River in Amber Bay and near the runway on Ocean Beach by Nakalilok Bay (Memo by Len Schwarz, December 4, 1990).

Sport fishing is generally perceived in the area as an internal effort, posing no threat to other user groups; however, although residents do not currently resent sport fishing activity, they are afraid that an expanded external sport fishery might negatively impact the other fisheries. Furthermore, the RPT recognizes that although conflicts between various user groups may occur, they are not irreconcilable.

Commercial Fisheries

The management area of the Chignik commercial salmon fishery is divided into five districts that are (from east to west) the Eastern, Central, Chignik Bay, Western, and Perryville Districts (see Fig. 2). It is the job of Commercial Fisheries (ADF&G) managers to achieve desired salmon escapements and allow for orderly harvests of the surplus. Purse seines are the only legal commercial gear type for the Chignik region; in 1990, 101 permit holders participated in the salmon fisheries (Table 8). The 1989 total harvest (1.26 million) was less than one-half the 1980-1989 annual average of 2.7 million fish (Table 9, Fig. 4). The sockeye and chinook harvests were within predicted ranges, while pink and chum catches were well below projected levels. This was attributable to the presence of oil contaminants (i.e., Exxon Valdez oil spill at Bligh Reef in northeastern Prince William Sound) in Chignik management area that precluded harvest of surplus local pink and chum stocks. Coho catches were also lower than projected.

Table 6. Estimated number of anglers and hours spent (effort) for the chinook salmon sport fishery on the Chignik River, 1989.

	Period[a]			
	A	B	C	All Periods
No. Anglers	22	18	23	69
Effort (hr)	35	217	437	689

[a] A = 0600-1159 hrs; B = 1200-1659 hrs; C = 1700-2300 hrs.

Table 7. Summary of angler demographics and types of lures collected from sport anglers fishing for chinook salmon in Chignik River, 1989.

Angler demographics				Types of Lures	
Females	16%	Residents	79%	Bait	0%
Males	84%	Nonlocals	54%	Spinners	97%
Adults	95%	Nonresidents	21%	Flies	3%
Youths	5%	Unguided	100%		

Table 8. Chignik area fishing effort in units of seine gear by resident status from 1966-1990.

Year	Units of Gear				Total
	Resident	Percent	Nonresident	Percent	
1966	65	89.0	8	11.0	73
1967	73	88.0	10	12.0	83
1968	59	88.1	8	11.9	67
1969	57	83.8	11	16.2	68
1970	57	82.6	12	17.4	69
1971	64	83.1	13	16.9	77
1972	62	78.5	17	21.5	79
1973	63	81.8	14	18.2	77
1974	79	84.0	15	16.0	94
1975	72	83.7	14	16.3	86
1976	66	85.7	11	14.3	77
1977	74	84.1	14	15.9	88
1978	82	86.3	13	13.7	95
1979	87	86.1	14	13.9	101
1980	87	86.1	14	13.9	101
1981	87	85.5	16	15.5	103
1982	89	84.8	16	15.2	105
1983	84	84.0	16	16.0	100
1984	84	83.2	17	16.8	101
1985	85	84.2	16	15.8	101
1986	87	87.0	13	13.0	100
1987	89	87.3	13	12.7	102
1988	88	86.3	14	13.7	102
1989	86	84.3	16	15.7	102
1990	85	84.2	16	15.8	101

Table 9. Historical salmon harvests in the Chignik Management Area, 1960-1990[a].

Year	Catch by Species: Chinook	Sockeye	Coho	Pink	Chum	Total
1960	643	715,969	8,933	557,327	486,699	1,769,571
1961	409	322,890	3,088	443,510	178,760	948,657
1962	435	364,753	1,292	1,519,305	364,335	2,250,120
1963	1,744	408,606	9,933	1,662,363	112,697	2,195,343
1964	1,099	556,890	2,735	1,682,465	333,336	2,576,425
1965	1,592	599,553	9,602	1,118,158	120,589	1,849,494
1966	636	219,794	16,050	683,215	238,883	1,158,578
1967	882	462,000	13,150	108,981	75,543	660,556
1968	674	977,382	2,200	1,290,660	223,861	2,494,777
1969	3,448	394,135	18,103	1,779,736	67,721	2,263,143
1970	1,225	1,325,883	15,348	1,287,605	464,674	3,094,735
1971	2,010	1,016,136	14,557	612,290	353,952	1,998,945
1972	464	378,669	19,615	72,240	78,356	549,344
1973	525	870,352	22,322	25,445	8,701	927,345
1974	255	662,905	12,245	70,017	34,454	779,876
1975	549	399,593	53,283	66,165	25,161	544,751
1976	763	1,163,728	35,301	388,917	80,221	1,668,930
1977	711	1,972,207	17,429	604,824	110,452	2,705,623
1978	1,603	1,576,283	20,212	985,114	120,889	2,704,101
1979	1,266	1,049,497	93,146	2,056,999	188,169	3,389,077
1980	2,325	859,966	117,862	1,125,465	312,572	2,418,190
1981	2,694	1,839,469	78,805	1,162,613	580,332	3,663,913
1982	5,236	1,521,857	300,384	873,390	390,096	3,090,963
1983	5,488	1,824,175	61,915	321,160	159,362	2,372,100
1984	4,318	2,660,478	110,128	446,184	63,408	3,284,516
1985	1,919	922,151	206,624	174,966	26,146	1,331,806
1986	3,037	1,645,834	116,633	647,125	176,640	2,589,269
1987	2,651	1,898,838	150,414	246,775	127,261	2,425,939
1988	7,296	795,841	370,410	2,997,159	267,126	4,437,832
1989	3,542	1,159,287	68,233	27,712	1,624	1,260,398
1990	9,901	2,093,650	130,131	550,008	270,004	3,053,694
31-year avg.	2,237	1,053,180	67,745	825,413	194,904	2,143,478
10-yr avg. (1981-90)	4,608	1,636,158	159,368	744,709	206,200	2,751.043

[a] Harvest numbers do not include Cape Igvak or Southeastern District mainland area.

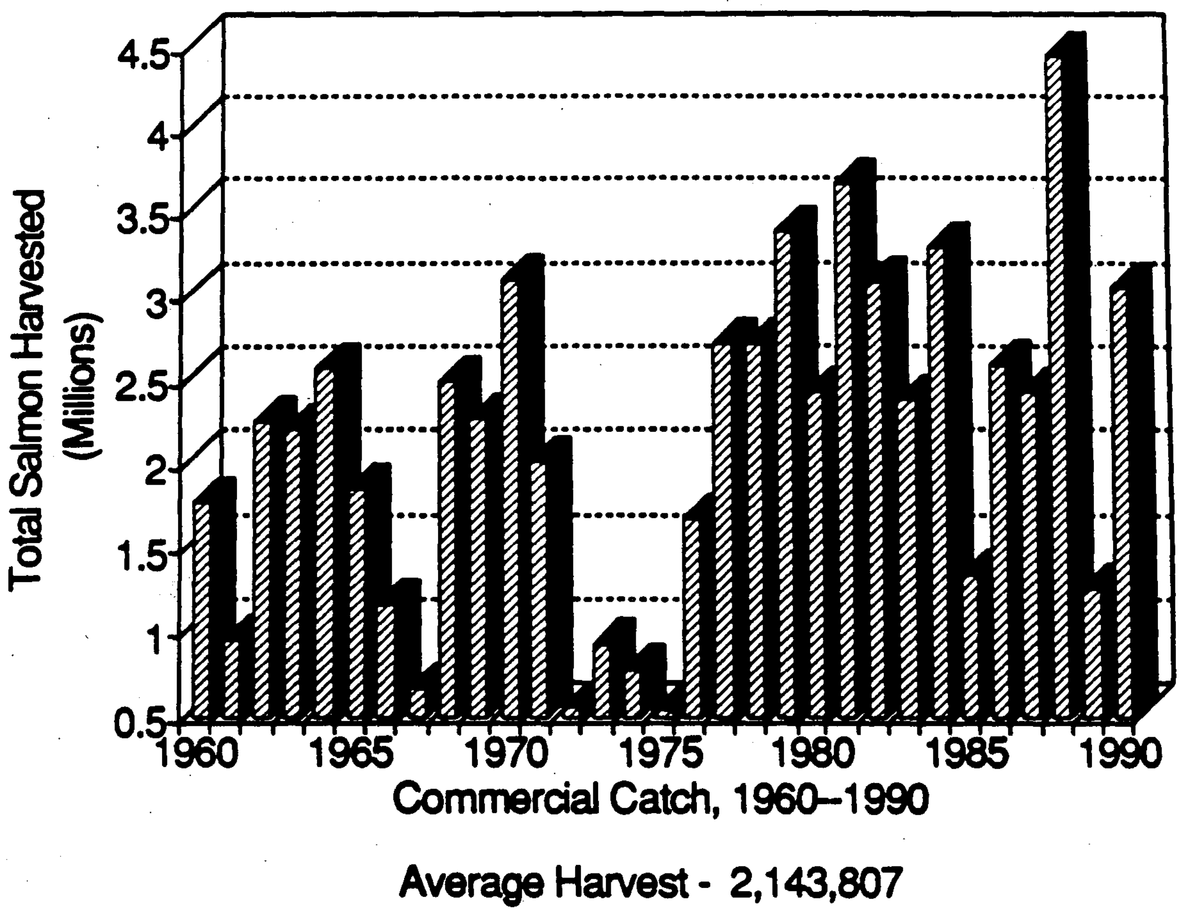


Figure 4. Chignik management area historical total salmon harvest.

Commercial fishing has been the region's most important cash-producing activity for much of the twentieth century. It has also been a factor for the harvesting of local resources for domestic uses. Access to commercial salmon fishing within state waters is limited to persons holding a permit issued by the Commercial Fisheries Entry Commission (CFEC). Beginning in 1975, CFEC has been issuing commercial purse seine permits to qualified persons. Eligibility was determined by a complex system based on points awarded by criteria such as residency and past participation in the fishery. Halibut fishing is controlled by the International North Pacific Halibut Commission; in order to commercially fish for halibut, an annual license is required and all vessels over 5 tons must be licensed.

The sockeye salmon run into the Chignik River system is the most important fishery in the region, occurring in two separate periods. The early run (Black Lake stock) enters the system in early June, peaking towards the end of June just as the late run (Chignik Lake stock) begins. The second run peaks in the latter part of July and continues late into the fall. Four other Pacific salmon species are taken simultaneously with sockeyes: chinook, which generally run at the early part of the season, followed by pinks, chums, and cohos.

In 1990 salmon for commercial purposes could be harvested in the Chignik region (see Fig. 3) only by hand or purse seine. In all districts except Chignik Bay, seine gear could not be less than 100 nor more that 225 fathoms in length, while in Chignik Bay District the length of the seine was limited to 125 fathoms. In Chignik Bay the commercial salmon fishing season in 1990 opened in June and ran through September; weekly fishing periods were established by ADF&G emergency orders. All other districts were opened and closed to commercial fishing by emergency order. The types of commercial fisheries and degree of participation among residents of the region are illustrated in Table 10 (Morris 1987). The variety of fisheries in which local residents participated was influenced by the location of their communities. One hundred and one limited entry seine permits (i.e., 90 permanent and 11 interim entry) were issued for the Chignik region in 1990. Because of the small size of the fleet, Chignik fisherman tend to know each other or are related by kinship; consequently the fleet is more self-regulating than other Alaska fisheries. Purse seine crews generally consist of a skipper, skiffman, and three deckhands. According to Langdon (1986) fishermen from the communities of Chignik and Chignik Lagoon not only have consistently reported the highest gross earnings from commercial fishing, but they have upgraded their boats to be more adaptable for fishing for nonsalmon species. The presence of only one commercial gear group in the region is conducive to harmony among fishermen; however, minor conflicts exist between inside (Chignik Lagoon, 75%) and outside (25%) fleets, where the trend is for more fishermen to move outside.

Fishing is the mainstay of the cash economy in the villages. Beginning around the second week in June, residents fish for sockeye salmon and successional runs of pink, chum, and coho salmon. Fish are taken by purse seiners and delivered to the local cannery or to floating processors anchored in Anchorage Bay. Boats, crews, and families from several area villages and elsewhere congregate in Chignik during the salmon season. Boats tie up to both cannery docks. There is not enough room for all the boats; therefore, boats tie up side by side or anchor in the bay. The economic well-being of the region depends on the success of salmon fishing.

Table 10. Commercial fisheries in which the surveyed households (N[a]) in the communities of the Chignik region participated (%) in 1984.

Fishery	Chignik Bay (N = 19)	Chignik Lagoon (N = 17)	Chignik Lake (N = 23)	Ivanof Bay (N = 6)	Perryville (N = 20)
Salmon	84.2	82.4	82.6	50.0	80.0
Crab	15.8	11.8	0.0	0.0	0.0
Herring	15.8	41.2	17.4	0.0	0.0
Halibut	84.2	88.2	82.6	66.7	96.0

[a] N = No. of households surveyed in each community.

SALMON PRODUCTION STATUS

Chinook Salmon Background

Chinook production in the region is limited to the Chignik River system, whose stocks return primarily during July and August. Commercial catches of chinook salmon are incidental to sockeye catches and generally peak during July; since 1960 the annual harvests have averaged 2,237 fish (Table 9). Commercial catches have increased in recent years, averaging 4,608 fish from 1981 to 1990 (Fig. 5); there has also been a corresponding increase in chinook escapement for the past 10 years. Escapement estimates are considered conservative because of the difficulty in distinguishing smaller chinook salmon from sockeye salmon as they pass through the weir. Total ex-vessel value of the 1990 chinook salmon harvest was $185,256 (Thompson and Owen 1992). Average earnings per permit holder was $1,834 (Table 11).

Sockeye Salmon Background

For the Chignik region, sockeye salmon are the most important commercially caught species from an economic viewpoint. The commercial fishery targets on the two runs of sockeye salmon entering the Chignik Lakes system. The Chignik Lake bound sockeye salmon are also intercepted outside the region in two historic fisheries, one to the east in the Kodiak Management Area (Cape Igvak) and one to the west in the Alaska Peninsula Management Area (Balboa-Stepovak).

Although most of the sockeye salmon production comes from the Chignik Lakes system, some spawning activity occurs in the Eastern District. Sockeye salmon in the Eastern District spawn predominantly in Albert Johnson Creek and Surprise Lake, both tributaries to Aniakchak River. Relative to the Chignik Lake sockeye stocks, the other stocks are of minor commercial importance. Most sockeye harvested in the Eastern District are intercepted as they migrate to spawning areas outside the district. Lechner (1969) summarized several years of tagging data from the Aniakchak and Cape Kumlik areas that showed sockeye salmon harvested in these waters were almost exclusively of Chignik Lake origin.

Sockeyes returning to the Chignik Lakes system are composed of one stock returning to Black Lake (early run) and the other to Chignik Lake (late run); sockeye escapement goals for Black and Chignik Lake stocks are 400,000 and 250,000 fish, respectively. Commercial fishing time for sockeyes have been based on a threshold level of escapement for each run by a specific date. To achieve these thresholds, the escapements are monitored; however, these monitoring efforts have been complicated by an overlapping in early and late runs' time of entry (i.e.,transition period). The transition period generally occurs from the last of June through mid-July. Two methods have been developed to estimate daily proportions of each run during the transition period. The first method is based on tagging studies (Dahlberg 1968). These studies (1962-1967) enabled biologist to develop an average time of early entry curve (ATOE) to apportion the Chignik sockeye runs into early and late components. A form of this method is currently used for in-season management of the fishery. The second method, developed in the late 1970s

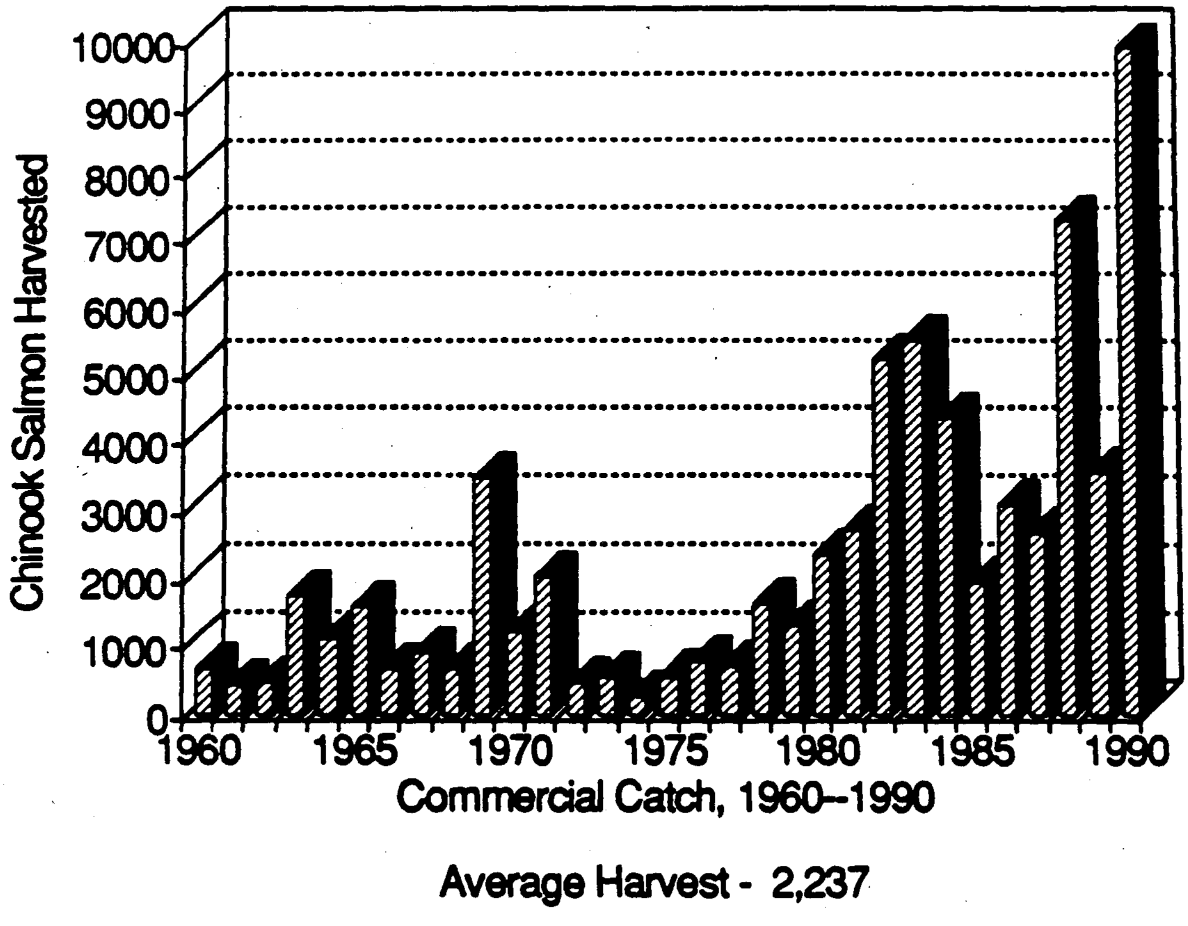


Figure 5. Chignik management area historical chinook salmon harvest

Table 11. Economic value (in dollars) of salmon to Chignik area fishermen, 1970-1990.

Year	Chinook		Sockeye		Coho		Pink		Chum		Total Value
	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average	
1970	6,129	89	2,190,272	31,743	18,397	267	635,673	9,213	376,025	5,450	3,226,496
1971	6,472	84	2,034,279	26,419	23,240	302	366,693	4,762	326,760	4,244	2,757,444
1972	2,028	28	825,498	11,308	35,699	489	48,401	663	87,759	1,202	99,385
1973	5,255	72	3,030,057	41,508	73,663	1,009	20,610	282	10,180	139	3,139,765
1974	2,941	32	3,618,781	39,767	31,933	351	64,069	704	51,125	562	3,768,849
1975	6,561	76	1,384,271	16,240	213,539	2,581	104,115	12,211	61,704	717	1,770,190
1976	13,800	179	4,751,000	61,701	138,000	1,792	568,300	7,381	183,600	2,384	5,654,700
1977	18,828	212	14,553,720	163,525	104,819	1,178	920,881	10,347	368,066	4,136	15,966,314
1978	56,700	597	15,653,500	164,774	116,400	1,225	1,131,500	11,911	404,500	4,258	17,362,600
1979	32,050	317	11,345,503	112,332	710,192	7,031	2,622,269	25,963	126,866	1,256	14,836,880
1980	67,657	670	5,532,290	54,775	520,655	5,155	1,477.060	14,624	1,061,963	10,514	8,659,625
1981	75,231	730	17,262,119	167,593	439,900	4,271	1,881,334	18,265	2,431,421	23,606	22,090,005
1982	75,276	717	13,038,510	124,176	1,782,027	16,972	578,184	5,506	1,356,597	12,920	16,830,594
1983	96,159	962	10,728,088	107,281	219,650	2,197	240,171	2,402	421,713	4,217	11,705,781
1984	114,502	1,134	20,402,076	202,000	759,972	7,525	330,916	3,276	146,024	1,446	21,753,490
1985	67,088	664	7,997,834	79,186	1,471,418	14,568	140,076	1,387	59,475	589	8,735,891
1986	84,800	848	16,882,290	168,823	667,740	6,677	356,147	3,562	456,546	4,565	18,447,523
1987	72,739	706	24,783,033	240,612	1,035,129	10,050	269,868	2,620	339,819	3,299	26,500,588
1988	286,740	2,811	14,350,354	140,690	4,153,424	40,720	6,771,266	66,385	2,189,293	21,464	27,751,077
1989	78,999	790	13,047,378	130,474	436,892	4,369	32,994	3,299	4,745	47	13,601,008
1990	185,256	1,834	22,509,923	222,871	700,309	6,934	502,693	4,977	878,510	8,698	24,776,691

and early 1980s, is based on differences in scale patterns between fry rearing in Black Lake and those in Chignik Lake (Marshall and Burgner 1975, Conrad 1983). Sockeye fry rearing in Black Lake (early run) emerge earlier and grow at a faster rate than fry rearing in Chignik Lake (late run) (Narver 1966). The faster growth rate experienced by Black Lake fry allow the majority to attain smolt length at age 1.0, while fry rearing in Chignik Lake experience a slower growth rate and generally smolt at age 2.0. Historically, this has been recognized in the adult return. The returns to Black Lake have been characterized by the dominance of age 1.3 fish, while the Chignik Lake returns have been primarily age 2.3 fish. Because these differences in early life histories are reflected in the scale patterns, they supply the discriminating variables used in the scale pattern analysis program.

For the period of 1960-1990, the average commercial harvest of sockeye salmon has been 1,053,180 adults, and for the period of 1981-1990, the average commercial harvest has been 1,636,158 adults (see Table 9, Fig 6). In 1989, the presence of oil contaminated waters (resulting from the Exxon Valdez oil spill) and beaches near Kilokak Rocks and the lack of associated monitoring in the Chignik Management Area dictated that waters of the Eastern District north of 56° 59' north latitude be closed to fishing. Oil was observed in varying quantities throughout the Eastern and Central Districts up to a point near the head of Chignik Bay at Unavikshak Island (Barrett and Monkiewicz 1989). Although oil was reported in Chignik Bay, the amount of contamination (sheen) within Chignik Lagoon did not appear to exceed a level associated with about 100 vessels operating there. Because of the presence of oil-contaminated beaches in the immediate vicinity of Chignik Lagoon, a policy of fishing during daylight hours only was adopted. On August 4, 1989, oil from the Exxon Valdez oil spill, in the form of mousse, was located inside Chignik Lagoon and scheduled fishing periods on August 5-6 were canceled (Barrett and Monkiewicz 1989). In 1989 the ex-vessel value of the sockeye harvest in the Chignik Management Area was approximately $13.1 million (Thompson and Owen 1992); in 1990 the total economic value of the sockeye harvest was $22.5 million. The average values/permit holder in 1989 and 1990 were $130,500 and $222,900, respectively (Table 11).

The Fisheries Research Institute (FRI), University of Washington, has maintained a salmon research facility at the outlet of Chignik Lake since 1955. The goal of their research (which has been funded by contracts or contributions from U.S. National Marine Fisheries Service, State of Alaska, salmon processors, and fishermen) has been to develop techniques for improved management of sockeye salmon.

Pink and Chum Salmon Background

Pink and chum production in the Chignik region is sporadic from year to year; this erratic production is directly related to the morphology of the river and stream systems of the Chignik region that are characterized by loose substrate, steep gradients and short overall lengths. These systems are impacted by fall, winter, and spring floods that cause stream bed scouring, which may result in high egg and fry mortality. Management of the pink and chum fisheries in the Chignik region are based on in-season aerial assessment of escapement and catch per unit effort (CPUE) data collected during fishing periods. Currently, all salmon processed locally are for

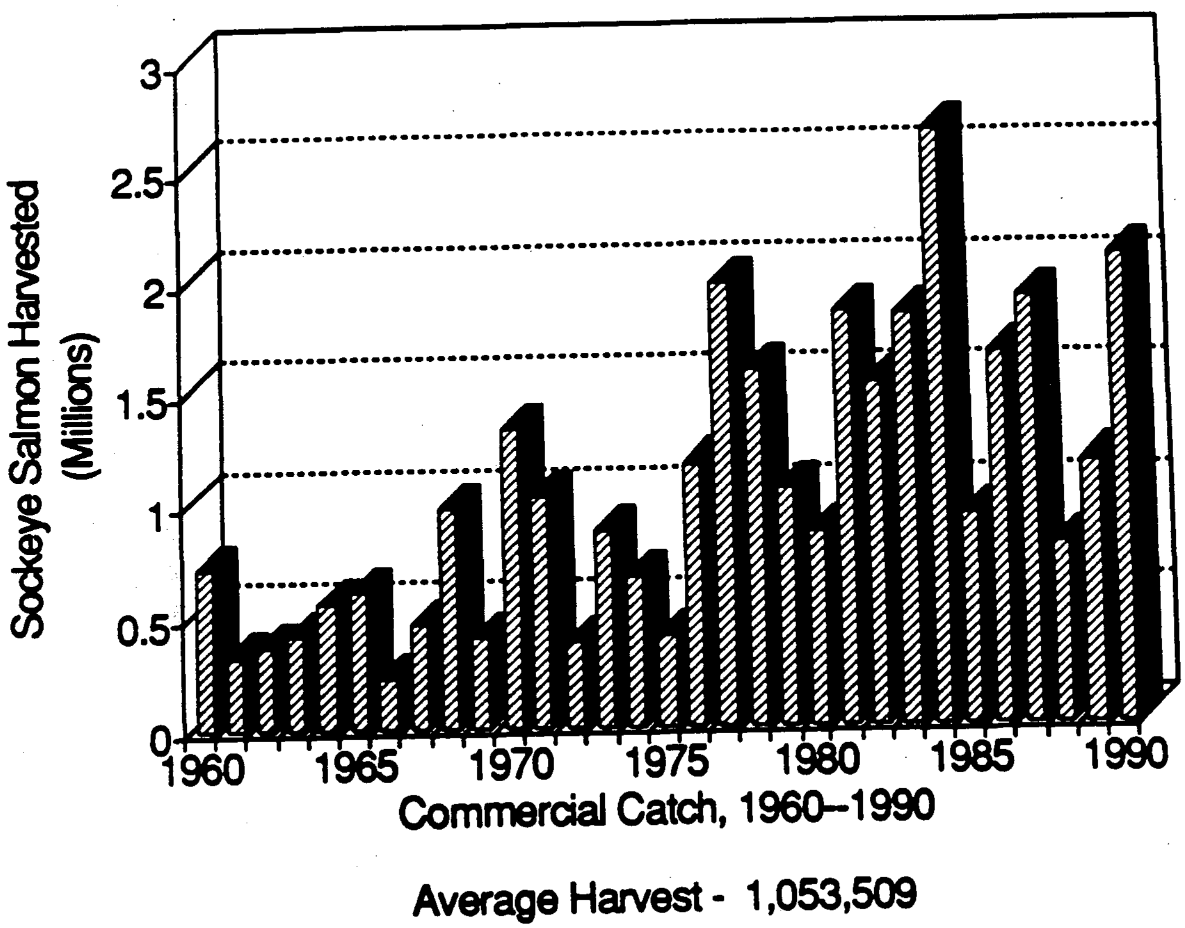


Figure 6. Chignik management area historical sockeye salmon harvest.

the fresh-frozen market because there are no operational canning facilities in the area. Consequently, to provide the quality required for fresh frozen processing, the fisheries are managed to intercept migrating fish prior to or just as they reach terminal waters. For the periods 1960-1990 and 1981-1990, the average commercial harvests of pink salmon have been 825,413 and 744,709 adults, respectively (see Table 9, Fig. 7). For the periods 1960-1990 and 1981-1990, the average annual commercial harvests of chum salmon have been 192,904 and 206,200 adults, respectively (Fig. 8). The 1989 pink and chum fisheries were severely restricted because of the presence of oil contaminated waters or beaches (1989 Exxon Valdez oil spill) in the Eastern, Central, Western, and Perryville Districts of the Chignik region. Since most of the pink and chum production comes from these districts, there was no opportunity to harvest fish surplus to spawning requirements. Because of oil-related fishery closures, the average ex-vessel values of pink ($33,000) and chum ($4,700) salmon were extremely low in 1989; compared with the 1990 average ex-vessel values of $502,700 and $878,500, respectively (Table 11).

Coho Salmon Background

Coho salmon spawn throughout the Chignik region; however, most of the coho spawning occurs in the Chignik Lake system. Coho salmon first appear in the commercial fishery in about mid-July and are still present when the commercial fishery terminates in October. In comparison to other coho producing systems of the Westward region, the Chignik River system usually supports the largest coho harvests. Since 1976, commercial harvests have ranged from a low of 17,429 in 1977 to a high of 370,400 in 1988; the 1981-90 average harvest is 159,368 coho salmon (see Table 9, Fig. 9). Total coho production of the Chignik River system averaged 170,000 fish during 1979-1988, based on catch and effort relationships to estimate spawning escapement after weir removal (Ruggerone 1989).

In recent years, coho salmon catches in the Chignik region have shown a bimodal pattern with respect to time. Early coho salmon harvests start in late July during the targeted pink and chum salmon fishery, and late coho salmon catches extend from mid-August through the remainder of the season. Early coho salmon catches come from the Western and Perryville Districts. These fish usually have a smaller average weight than those caught during August and September. Based on timing information and average weights, an unknown portion of the early coho salmon catch are considered to be nonlocal stocks. From mid-August through the end of the season coho salmon are harvested primarily in the Chignik Bay District and are considered local stocks. Because of oil-related closures in the Eastern, Central, Western, and Perryville Districts, the entire 1989 harvest was in the Chignik Bay District. The ex-vessel value of the coho salmon catch to the Chignik fishermen was an estimated $700,300 in 1990, and average earning per permit holder was $6,900 (Table 11).

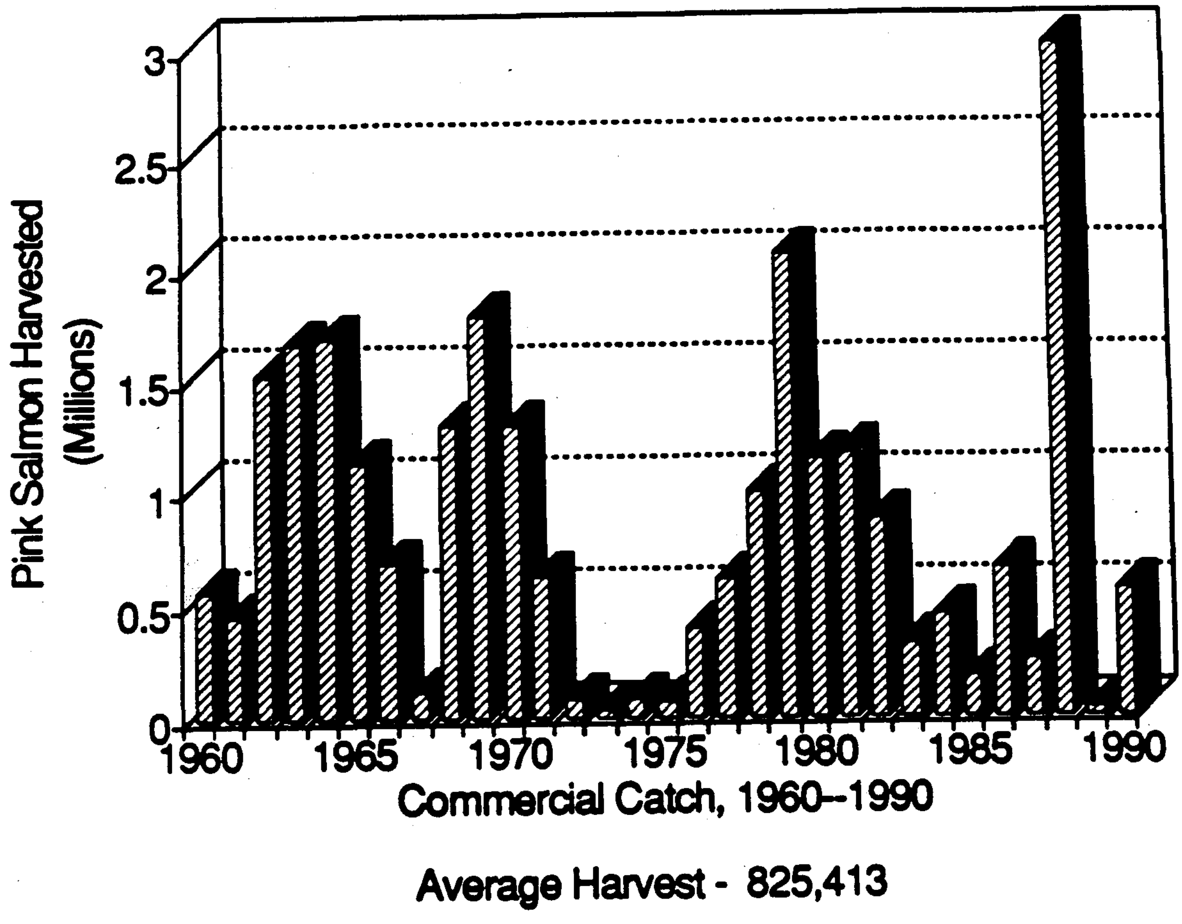


Figure 7. Chignik management area historical pink salmon harvest.

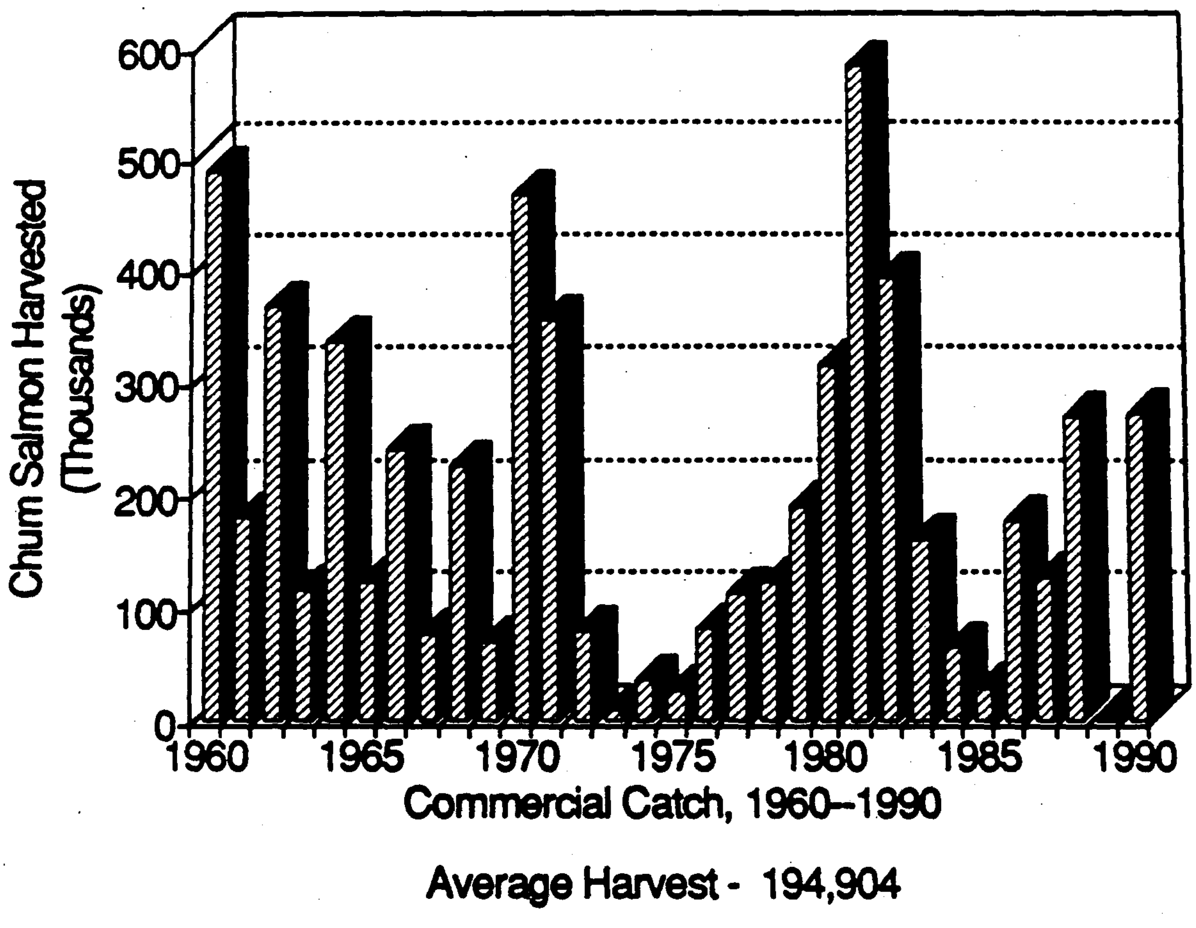


Figure 8. Chignik management area historical chum salmon harvest.

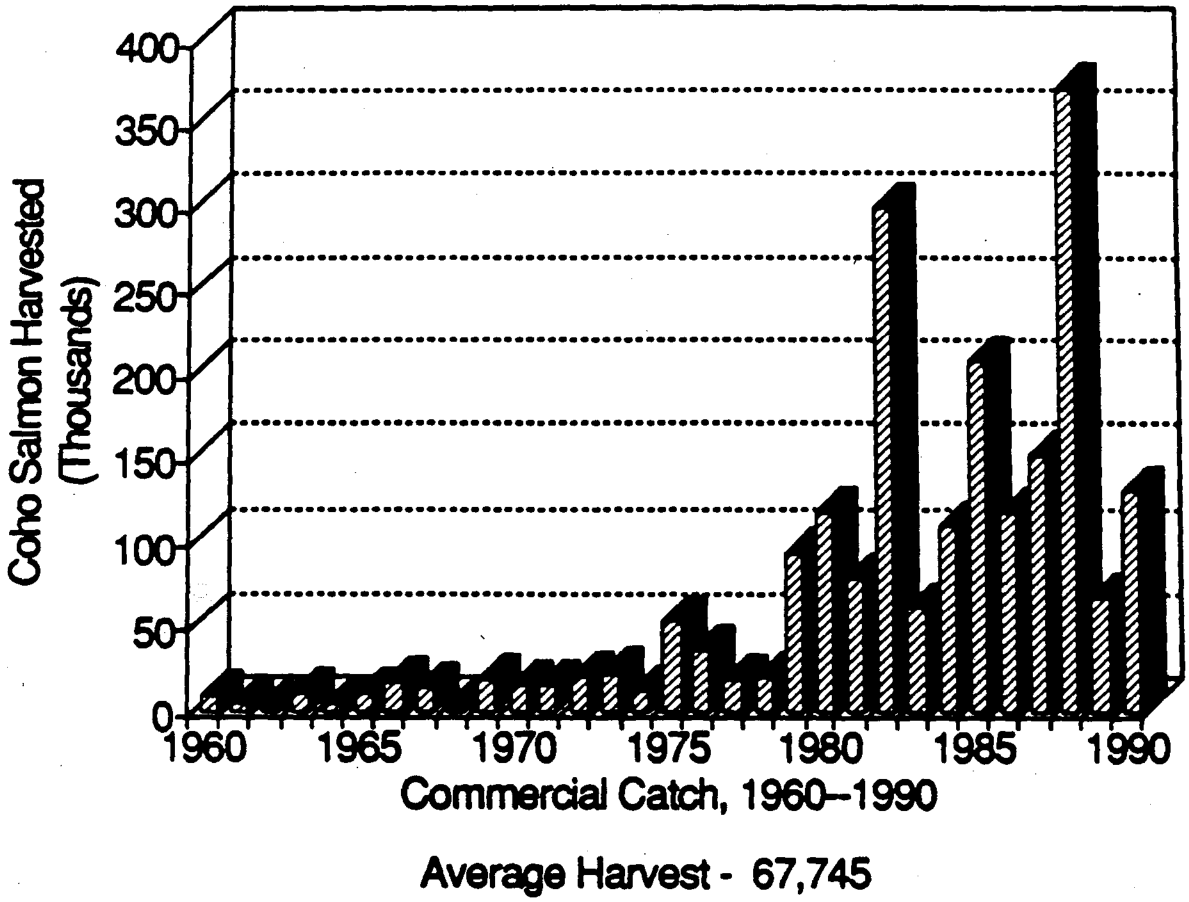


Figure 9. Chignik management area historical coho salmon harvest.

ANALYSIS OF REGIONAL STATUS

User Demand

The production of additional salmon in the Chignik region is a means of strengthening and preserving a resource base for subsistence, recreational, and commercial harvests. Historic patterns in the regional fisheries support the contention that when more fish are available to be caught, the resulting increased harvest is distributed throughout the user groups; therefore, the production of more fish in the region would be beneficial to these user groups.

The achievement of more productive and predictable salmon fisheries in the Chignik region will require identification of what the region's fishermen want from the resource and what the resource will be able to provide. Although the projects outlined in later chapters of this plan will provide for the orderly and systematic examination of the resource potential, the primary assumption here is that as the resource base increases, harvests will accordingly be allowed to increase in a biologically sound manner. A key element in the relationship of user groups to a potentially expanding resource base is the number of participants in the harvest; however, because (1) only one commercial gear group for salmon is represented (i.e., 101 CFEC seine permits), (2) subsistence harvests are generally considered adequate because of the remoteness of the region and large seasonal population, and (3) sport fishing has not appreciably developed beyond a localized level, although Chignik Lake-River, Ltd. is investigating possibilities (mostly in Chignik River), the level of participation in the various fisheries are not anticipated to dramatically increase over the life of the plan. There is the possibility that sport fishing pressure from guided charter-boat operations at Amber Bay and Aniakchak are increasing; however, their impact on the area's sport fishery has not yet been quantified.

Chignik Questionnaire Summary

With the intentions of (1) determining major issues and concerns in the Chignik region and the best means of addressing them and (2) reaching as many of the region's fishermen as possible in the planning process, the Chignik Regional Planning Team drafted a 20-part questionnaire (Appendix B) that was mailed to all permanent and interim commercial seine permit holders as well as all processors in the region. Approximately 30% of those receiving the questionnaires responded. The three most important problems associated with the commercial fisheries were ranked as follows: (1) price/markets, (2) lack of fish, (3) overcrowding. The highest ranked project possibilities were clearly (1) stabilization of water levels of Black Lake, (2) diversion of Alec River, and (3) implementation of studies to evaluate the production/carrying capacity of Chignik and Black Lakes. In response a question regarding the species of salmon they wanted to see increased, sockeyes ranked first, followed by cohos, chums, chinooks, and pinks.

In additional findings, only 3 fishermen indicated annual gross income percentages less than 80% derived from Chignik fisheries, while two said they relied on fisheries in other regions for the remainder of income; of 28 fishermen reporting the bulk of their income from salmon seining in the Chignik region, the average was 95.3%. Respondents indicated they needed an average annual gross income of $300,000; the average investment for boat, permit, and gear amounted to $745,400. Seventy-three percent said they took a portion of their commercial catches for personal use; sockeyes were decisively ranked first, followed by chinooks, cohos, pinks, and chums. All but two of the respondents indicated Chignik Bay as the principal area for increasing production of sockeye salmon, followed by Central, Westward, Eastern, and Perryville Districts.

When asked if their regional aquaculture association (CRAA) should consider sockeye hatcheries as a viable production means, provided a location could be found where reasonable segregation from natural stocks could be accomplished, 52% of the respondents said "possibly," 33% said "yes," and 15% said "no." Also an overwhelming majority indicated that harm to the natural stocks was their greatest concern when considering hatcheries. Based on these responses and supplemental comments by members of the CRPT, the introduction of hatcheries into the context of 5-year planning was not considered an appropriate option, although enough interest was generated to perhaps identify possible sites with sufficient quality and quantity of water to locate a hatchery facility.

Marketing Alaska Salmon

In 1981 the Alaska Legislature created the Alaska Seafood Marketing Institute (ASMI) and charged them with two mandates: (1) to promote Alaska seafood consumption in domestic and world markets and (2) to promote quality. In promoting seafood consumption, this agency uses print and broadcast media as well as trade promotions, direct mailouts, industry trade shows, and dissemination of recipes. To promote the quality of seafood as the best the market place has to offer, they provide videos, handling guides, and other printed materials to fishermen, wholesalers, and retailers (ASMI 1992a). Following the crisis years of the early 1970s when salmon production throughout the state had reached record lows, Alaska began developing and implementing its public and private nonprofit hatchery/salmon ranching program. By the beginning of the 1980s salmon production was moving upward and by the end of the decade it had increased exponentially. Throughout the 1960s and 1970s Alaska fishermen harvested an average of about 254 million pounds of salmon per year, but during the 1980s, the average harvest more than doubled to about 593 million pounds--and for the first two years of the 1990s, Alaska has produced salmon at a rate of 707 million pounds per year (ASMI 1992b).

During this same period countries like Chile, Norway, and Canada entered into the market with salmon that had been commercially produced on farms, although it had never exceeded 1% of the world market before the 1980s. Within 10 years, global salmon farmers went from about 15 million pounds of total production in 1980 to 479 million pounds in 1989--in 1991 salmon farmers harvested 673 million pounds (Table 12)

Alaska annually spends millions of dollars managing and enhancing its salmon resources; however, the value comes from the market place and not from the size of the harvest, which was painfully evident when fishermen lost more than $240 million in ex-vessel value of salmon in 1991 despite the record harvest of 186 million salmon. Consequently, there are many issues that need to be addressed before domestic expansion of the salmon market occurs. Consumer and

Table 12. World salmon production in pounds, including % of Alaska's contribution, 1976-1991 (ASMI 1992b).

Year	World	Alaska	Farmed	Alaska %	Farmed %
1976	878,000,000	245,000,000	4,000,000	28%	--
1977	1.029,000,000	307,000,000	5,000,000	30%	1%
1978	969,000,000	389,000,000	8,000,000	40%	1%
1979	1,261,000,000	442,000,000	10,000,000	35%	1%
1980	1,242,000,000	511,000,000	15,000,000	41%	1%
1981	1,379,000,000	612,000,000	26,000,000	44%	2%
1982	1,307,000,000	562,000,000	35,000,000	43%	3%
1983	1,595,000,000	618,000,000	49,000,000	31%	3%
1984	1,512,000,000	658,000,000	74,000,000	44%	5%
1985	1,847,000,000	668,000,000	102,000,000	36%	6%
1986	1,653,000,000	605,000,000	156,000,000	37%	9%
1987	1,630,000,000	487,000,000	210,000,000	30%	13%
1988	1,726,000,000	525,000,000	319,000,000	30%	18%
1989	2,287,000,000	711,000,000	479,000,000	31%	21%
1990	2,237,000,000	689,000,000	621,000,000	31%	28%
1991	2,563,000,000	726,000,000	673,000,000	28%	26%

trade perceptions related to the quality of Alaska products as well as prejudices against frozen salmon must be changed, the decline in canned salmon sales must be stopped, and everyone concerned (fishermen, processors, wholesalers, retailers, and consumers) must be educated on the value, preparation, and quality of Alaska salmon products. In order to improve the quality of salmon to a level surpassing those of Alaska's competitors, the entire industry (including processors, tender operators, and fishermen) must work together in a coordinated effort. The entire salmon industry needs to be reminded that Alaska salmon should set the standard in quality of the world market (ASMI 1992b).

Value-Added Processing Opportunities for Salmon

The level of production for pink and chum salmon may warrant investigating development of alternate types of products. The production of salmon mince may be an opportunity for utilizing these species. Subsequent production of mince into fashioned product forms (e.g., smoked minced product, salmon burger patties) will require additional investment in equipment and facilities. Steaking and microwavable pouch operations for sockeye salmon may also be practical to develop. The production and use of fish oil from Alaska seafood waste is currently being pursued on a variety of levels; the use of fish oil as a substitute for diesel fuel may be a practical and cost-saving opportunity. The production of fish meal from salmon wastes is also another value-added consideration (Pacific Associates 1992).

Genetic Issues

The State of Alaska has a genetics policy that governs rehabilitation, enhancement, and development of salmonid populations (Davis et al. 1985, Davis and Burkett 1989). This policy was written to provide guidelines for such activities while protecting the integrity and diversity of wild stocks, the mainstay of the commercial fishery economy. Interpretation of the policy has been expanded to incorporate protection of nonsalmonids, and the impacts of various projects on aquatic organisms ranging from mussels to sticklebacks to salmon are routinely reviewed during the various permitting processes. Projects addressed in this plan will be evaluated for conformance to the states's genetic policy. Before approval, the commissioner will determine that a proposed project can be conducted in a manner to ensure the health and diversity of the stocks and species in the affected area.

GOALS, OBJECTIVES, STRATEGIES, AND PROJECTS

Introduction

In as much as all goals are definitive statements concerning a specific end we wish to achieve by a specific date, the overall goals of all participants in the Chignik fisheries (i.e., commercial, sport, and subsistence) are to protect the wild stocks, increase and stabilize production and harvests, and generally improve fisheries in the region. What decides these improvements will be a series of discrete but related goals that may represent (1) a larger production and harvest of fish, (2) collection and evaluation of necessary data and research, and (3) revision of management policies and practices. Uniting these three types of goals are three basic assumptions: (1) the salmon resource needs to be maintained in the strongest possible condition (i.e., protection of wild stocks and habitat), (2) most effective management, rehabilitation, and enhancement strategies can only be realized through a complete data base, and (3) harvest of salmon resources to the greatest extent possible is beneficial to all participants, the region, and the state.

Production/Harvest Goals

Production and harvest goals are expressed in numbers of fish that will be available for harvest in Chignik's regional fisheries. Generally, these goals are expressed in conjunction with projects that have been identified by species and related production and harvest numbers.

Ten-Year Target:

The initial 5 years of the planning period will be devoted to habitat improvement projects and research; however, in addition to the various studies that have been and will be initiated, the CRPT decided to adopt a 5-year Action Plan for implementing projects such as the stabilization of the water level of Black Lake, Alec River diversion, stream passage improvement, stock status investigations, and beaver dam removal projects in order to achieve the regional need for consistency and stability in the harvest. A good understanding of the hydrology of the Black Lake system and the dynamics of the biology of the fish will be an important part of the development of projects there. Lake fertilization is another technique that can be implemented if Black and Chignik Lakes show sings of seasonal nutritional limitations. To these ends, the CRPT felt it was necessary to establish attainable 10-year harvest target numbers by species toward which the action portion of the plan could be directed. Accordingly, a 20% increase in the annual harvest over that for the most recent 10-year average (1981-1990) for each salmon species was selected as the 10-year target (Table 13); however these increases will occur in the 10 years following the implementation of enhancement and rehabilitation projects designed to increase production. If no projects are undertaken to increase production, then there is no expectation to achieve the 20% target per species; for example, thus far there are no plans to increase coho production, but we reflect the 20% harvest increase in Table 13 as a reference. Our overall goal is to realize the 20% harvest increase; i.e., 20% over the 10-year annual

Table 13. Chignik management area commercial salmon harvests, 10-year average (1981-1990) harvest, and 10-year/+20% (1992-2001) target.[a]

Year	Harvest by Species					Total
	Chinook	Sockeye	Coho	Pink	Chum	
1981	2,694	1,839,469	78,805	1,162,613	580,332	3,663,913
1982	5,236	1,521,857	300,384	873,390	390,096	3,090,963
1983	5,488	1,824,175	61,915	321,160	159,362	2,372,100
1984	4,318	2,660,478	110,128	446,184	63,408	3,284,516
1985	1,919	922,151	206,624	174,966	26,146	1,331,806
1986	3,037	1,645,834	116,633	647,125	176,640	2,589,269
1987	2,651	1,898,838	150,414	246,775	127,261	2,425,939
1988	7,296	795,841	370,410	2,997,159	267,126	4,437,832
1989	3,542	1,159,287	68,233	27,712	1,624	1,260,398
1990	9,901	2,093,650	130,131	550,008	270,004	3,053,694
Avg	4,608	1,636,158	159,368	744,709	206,200	2,751,043
+20%	5,530	1,963,390	191,242	893,651	247,440	3,301,253

[a] harvest data excludes Cape Igvak & Southeastern District (mainland area).

average, representing the harvest expected without implementation of enhancement or rehabilitation projects.

Many fisheries biologists believe that the salmon production in Alaska is heading into a cyclic downturn. If this occurs and if reliable, scientific data reflecting the impact of decreasing production in the Chignik area can be gathered, then this data could be factored into our assessment of our ability to achieve our 10-year targets; for example, if our best scientific data suggest that without enhancement/rehabilitation activities Chignik had experienced a 20% decrease in salmon production and harvests had still maintained the 10-year average harvest objectives, then it would be justifiable to conclude that we had achieved our target for that species. On the other hand, if wild salmon harvests increase throughout the state, we may have justification for attributing some of the local increase to factors other than or own rehabilitation/enhancement projects.

Research/Data Collection and Evaluation Goals

There are a number of necessary and associated studies that will not directly be expressed in production/harvest numbers but may indirectly result in more fish. These studies will contribute to a stronger fisherman/manager/resource relationship that, in turn, will contribute to increased production and more efficient harvests. For example, hydroacoustical and limnological investigations will help clarify the (1) manner and extent to which salmon are utilizing the Chignik and Black Lake systems and (2) increase in production per unit area of the lakes that can realistically be expected. Also, increased escapement monitoring and smolt studies or stock separation studies (for example, age-structure, run timing, scale analysis, genetics, etc.) in other systems in the region will further increase understanding of the resources' potential.

Policy/Management Goals

One of the corollary goals is to support adequate funding of proposed research, data gathering, and production projects that assist ADF&G, Division of Commercial fisheries managers in the region. As a matter of policy, the comprehensive plan would be continuously reexamined in the context of that new information. All efforts supporting continuation and improvement of relationships and coordination between state, private nonprofit associations, and federal agencies involved in rehabilitation and enhancement activities will ultimately benefit the resource and those using it. It also must be recognized that, although the primary goal of the plan is for the rehabilitation and enhancement to the area's salmon stocks that will ultimately benefit the user groups in the Chignik region (commercial, subsistence, and sport fishermen), it is not the intent of this comprehensive plan to produce fish that further complicate allocative decisions in our region or in adjoining regions.

Policy for Evaluating Habitat Modification Projects:

Safety, security, and enhancement of the salmon resource have the highest priority. Adequate scientific research and peer review concerning potential negative impacts of all habitat modification proposals will be accomplished before any such project is implemented. The consensus among scientific investigators will be that no negative impacts to the salmon resource will occur as a result of implementation of such projects. Accordingly, there should be reasonable scientific grounds for believing that a given habitat modification enhancement project will result in improved salmon runs, which is a less rigorous scientific standard than one that guarantees the success of such a project and its subsequent benefit to the resource and its users alike. Where the risk for a project is not related to damage to the habitat or salmon stocks but simply the potential failure of a project to enhance or rehabilitate a particular stock of salmon, then the risk is primarily a financial one borne by CRAA; accordingly, the CRPT may at its discretion choose to recommend implementation of such a project.

Objectives

The establishing of objectives is a process whereby long-term goals are broken down into attainable short-term increments (for example, 5-year increments within a 10-year plan). From this perspective, objectives are therefore benchmarks taken at a specified interval to measure a plan's progress and assess whether it is proceeding adequately toward meeting the goals; however, in Chignik the initial 5 years of planning will be devoted to habitat improvement projects and research. In addition to the various studies that have been and will be initiated, the CRPT has adopted an aggressive 5-year planning process for implementing projects such as the stabilization of the water level of Black Lake, stream passage improvement, stock status and limnology investigations, and beaver dam removal projects, in order to achieve the regional need for consistency and stability in the harvest. Moreover, the CRPT has selected a 20% overall increase in the harvest of each species of salmon by 2002 (10-year target); however, these increases per species will occur in the ten years following the initiation of rehabilitation and enhancement projects. To reach that single objective per species (see Table 13), the plan has set out strategies and projects in the 5-Year Action Plan (see page 63).

Strategies and Projects

Those general statements of priorities to guide specific actions of agencies and associations working toward research, management, enhancement and rehabilitation goals and objectives for the salmon resource are *strategies,* and the specific tactics and actions employed to address them all are the *projects*. As such, they represent the heart of the 5-Year Action Plan--a means of resolving the production, harvest, management, and research needs (in the short-term) of the region's users of the salmon resource. As each project is presented a complete description of the participants, the species involved, the work to be done, and the schedule for completion will be identified. It is through the projects that a fuller understanding of the salmon species of the region is attained, and they may be used singly or in combination to address strategies and achieve objectives and goals (i.e., results). The implementation of projects may indicate additional research is necessary, yield information applicable to other strategies, or contribute additional fish to the common property fisheries as well as new data to our understanding of the resource. In the context of the 5-Year Action Plan applicable strategies and projects will be provided for each of the goal categories (i.e., production and harvest, research and data collection and evaluation, and policy and management) for each species on a prioritized basis that are ranked as follows: (1) sockeye, (2) coho, (3) chum, (4) chinook, and (5) pink salmon.

Production/Harvest Strategies:

These strategies are designed to replenish depressed stocks and increase the number of naturally occurring salmon beyond levels that they would reach without intervention (e.g., use of rehabilitation and enhancement techniques). The following are strategies for the Chignik region that will be more thoroughly addressed in the following section: water flow and water level structures, improved techniques for escapement management, stream clearance, spawning channels, fish passes, predator control, lake or stream stocking, instream incubators, and lake fertilization.

Research/Data Collection and Evaluation Strategies:

These strategies provide effective tools for resource management. They are therefore indirect and supportive, compared with production and harvest strategies. By necessity they are employed in the long-term and demand a dedication of funding, staff, and consistency of approach in order to obtain the useful results. The following are general strategies that may be addressed during the course of the planning period: field surveys, computer modeling, data gathering, data analysis, qualitative sampling, fish enumeration, sockeye predator population studies, and stock separation studies. Information concerning salmon biology and migration (i.e., stock separation) characteristics as well as the level of contribution to various fisheries can be obtained from well designed stock separation studies. Information from this type of work is very helpful in the fishery management decision-making process to assure that harvest levels and escapement of the wild stocks can be maintained in balance and to allow for continued healthy perpetuation of the salmon runs. Additional information concerning movements and residence time of salmon in the coastal waters of the Alaska Peninsula would be very helpful.

Policy/Management Strategies:

Salmon populations in the Chignik region are managed on a sustained-yield basis. This requires the achievement of escapement goals to provide the seed for future production. When these escapement goals are assured, the remaining fish are available to the area's common property fisheries (subsistence, commercial, sport). Allocation of fish among user groups is the responsibility of the Alaska Board of Fisheries and is implemented by regulation. The focus for managers and fishermen alike in the Chignik area is to maintain and protect wild stocks by attaining the escapement goals for each species. Achievement of escapements into the major spawning systems is the priority. The following are general strategies that may be addressed during the course of the planning process: imposition of fishing periods, coordination of emergency closures and openings, escapement monitoring of all species to achieve reassessment of escapement goals for sockeye, test fishing, establishment of bag limits and licensing, limitation of entry into a commercial fishery (CFEC), imposition of gear specifications, and opening and closing fishing areas.

ENHANCEMENT, REHABILITATION, RESEARCH, AND MANAGEMENT TECHNIQUES

Definitions

The techniques used in the supplemental production of salmon will fall into one of two categories that are defined as follows: (1) Enhancement--the application to a stock already at natural capacity of procedures designed to increase the numbers of harvestable fish; this may be accomplished by using artificial or semiartificial production systems, increasing the natural productive habitat through physical or chemical modifications, or improving escapement management and (2) Rehabilitation--the application to a depressed stock or endangered habitat of management, fish propagation, or habitat restoration techniques to return them to a previously recorded level of production.

Fish Habitat Restoration and Improvement Techniques

Water Flow Structures:

Techniques such as stabilizing steam banks or installing structures (e.g., boulders, woody debris) to maintain riffles and pools in a stream are used to provide fish habitat. Water level or water flow direction in some instances can be adjusted with various structures to improve fish production. It is also possible to connect ponds to existing salmon producing systems to expand available rearing areas and thereby increase production. As with the other techniques that will be addressed, habitat manipulation projects must be carefully evaluated by CRPT prior to installation.

Water Level of Black Lake. Black Lake (Fig. 10) in the Chignik Lake system is an unusual sockeye lake because (1) it is exceptionally shallow (<4 m) and (2) adult sockeye production (e.g., run size; return/spawner) there fluctuates more than that of other major sockeye systems (Ruggerone et al. 1992). Sockeye production in Black Lake may be enhanced by stabilizing the lake's water level near the high-water mark. Recently, Ruggerone et al. (1991) suggested that the large fluctuations of adult sockeye returning to the lake were influenced by the lake's inability to buffer short-term fluctuations in weather. Furthermore, lake depth measurements, aerial photographs, and observations by local residents and previous researchers indicated the lake has become more shallow since 1960. Researchers are investigating (1) the amount of habitat lost during the winter because of low water levels as well as low dissolved oxygen levels, (2) avoidance of low dissolved oxygen levels by juvenile sockeye, (3) premature emigration of fry to Chignik Lake, and (4) effects of rapid water temperature increases on sockeye health. Furthermore, investigations are being initiated toward determining feasibility of stabilizing the level of Black Lake at about 1 meter above the low-water level and nearly double available sockeye habitat during the winter or early spring. Although the method for achieving lake stabilization has not been determined, the passage of upstream migrating adult and juvenile salmon as well as boats must be provided for. Based on sampling done in the spring of 1992,

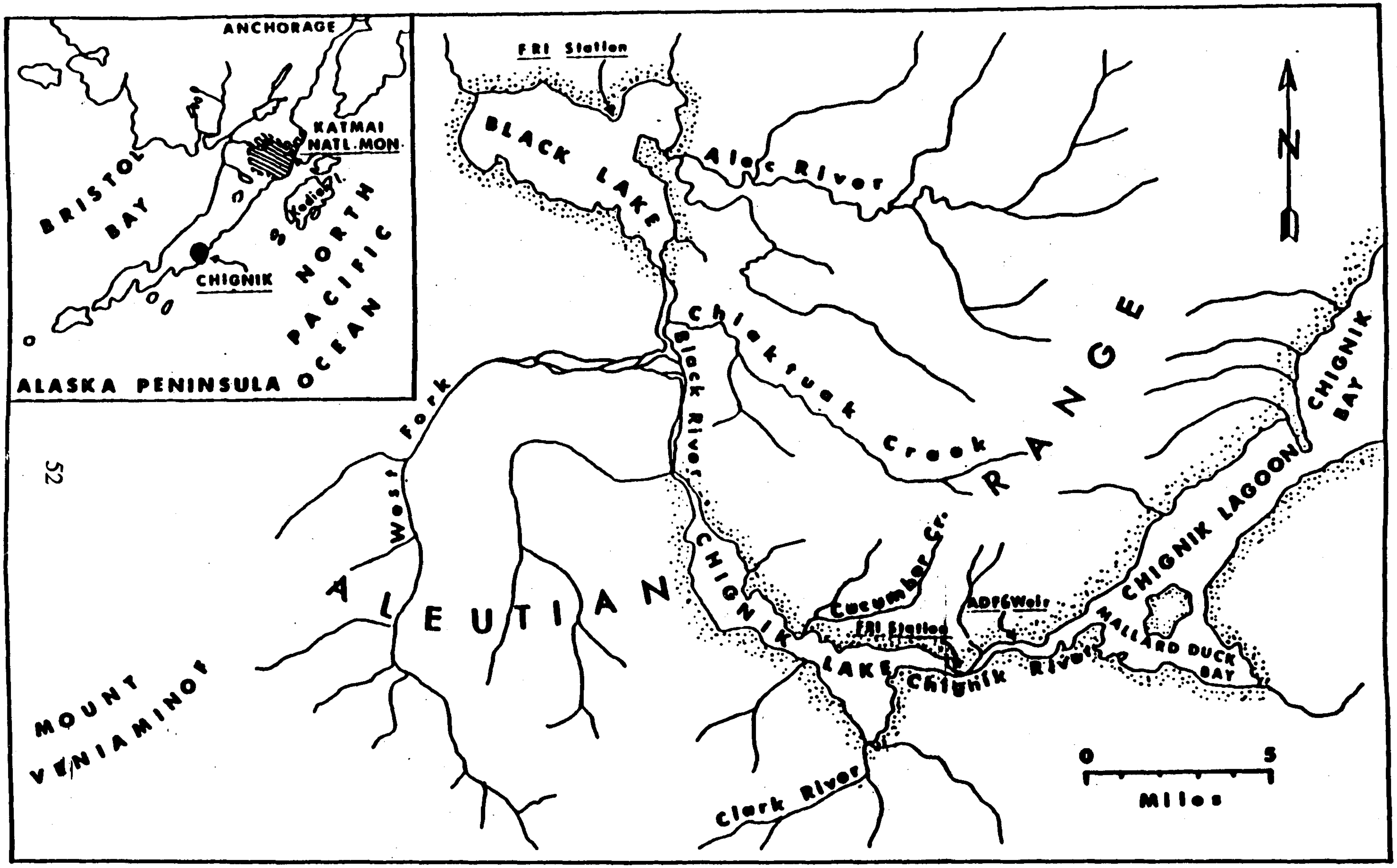


Figure 10. Chignik River drainage, showing locations of Chignik and Black Lakes (source: Kyle 1991).

it does not appear that significant numbers of sockeye fry migrate upstream into Black Lake; however, significant numbers of cohos and smelts do move upstream. Accordingly, these fish species would need to be accomodated in the design of a structure to raise/stabilize the level of Black Lake.

<u>Alec River Diversion.</u> The Alec River (also known as the Scow River) drainage (Fig. 11) supports the great majority of spawning sockeye salmon returning to Black Lake. Observations indicate that the river is changing course approximately 2 km (1.2 mi) upriver from the lake. Flow measurements made during a low-water period in 1990 demonstrated that 60% of the water entered a side channel leading to Fan Creek and the outlet portion of Black Lake. Comparison of aerial photographs during the late 1950s with recent observations indicate the amount of water draining to the lake outlet has grown. The changing distribution of water flow appears to have enhanced the rapid growth of the sandspit that separates the lake outlet from the main lake (Ruggerone and Denman 1990). At low water this sandspit crosses 80% of the lake. Observations by FRI researchers, who have spent several weeks at Black Lake during each year in the early 1960s, indicate that the sandspit has grown considerably.

Left unchecked, Alec River will probably shift towards the outlet of Black Lake and the sandspit crossing the lake will grow (Ruggerone and Denman 1990). Emerging sockeye in the Alec River would be carried downstream to the shallow outlet area (<1.5 m) and might migrate to Chignik Lake (as many do now), rather than find the entrance to the main lake area. To rectify this problem, researchers are investigating methods to divert water back to Alec Bay.

Stream Clearance:

Despite its simplicity and cost-effectiveness, this technique has some attendant risks. Complete removal of physical barriers (e.g., beaver dams, rocks; logs, driftwood, beach gravel deposits, or other debris) may, in turn, cause downstream scouring, elimination of pooling areas, or creation of velocity barriers; therefore, selective removal of a portion of a barrier sufficient to allow passage of fish upstream without substantially altering the flow of water or downstream conditions is required. When evaluating potential stream clearance projects, assessments should be made of the unutilized spawning or rearing habitat that will be made available, the portion of the barrier to be removed, the availability of sufficient spawning populations to make use of the new habitat, and the costs (time and equipment) involved.

Required applications vary from system to system; in some instances the rearranging of rocks or logs by hand to provide resting pools and shorten jumps over falls may be all that is needed. When beaver dams frequently block salmon streams or rearing habitat in the Chignik region, the temporary removal of portions of the dams also can be an effective means of modifying obstructions to provide access to spawning or rearing areas. Providing access to blocked side channels, lakes, or sloughs can also in some instances provide additional rearing area for coho.

Beaver Ponds, Water Levels, and Sockeye Production. According to local residents, the beaver population in the Chignik area has increased substantially during the past 20 or 30 years.

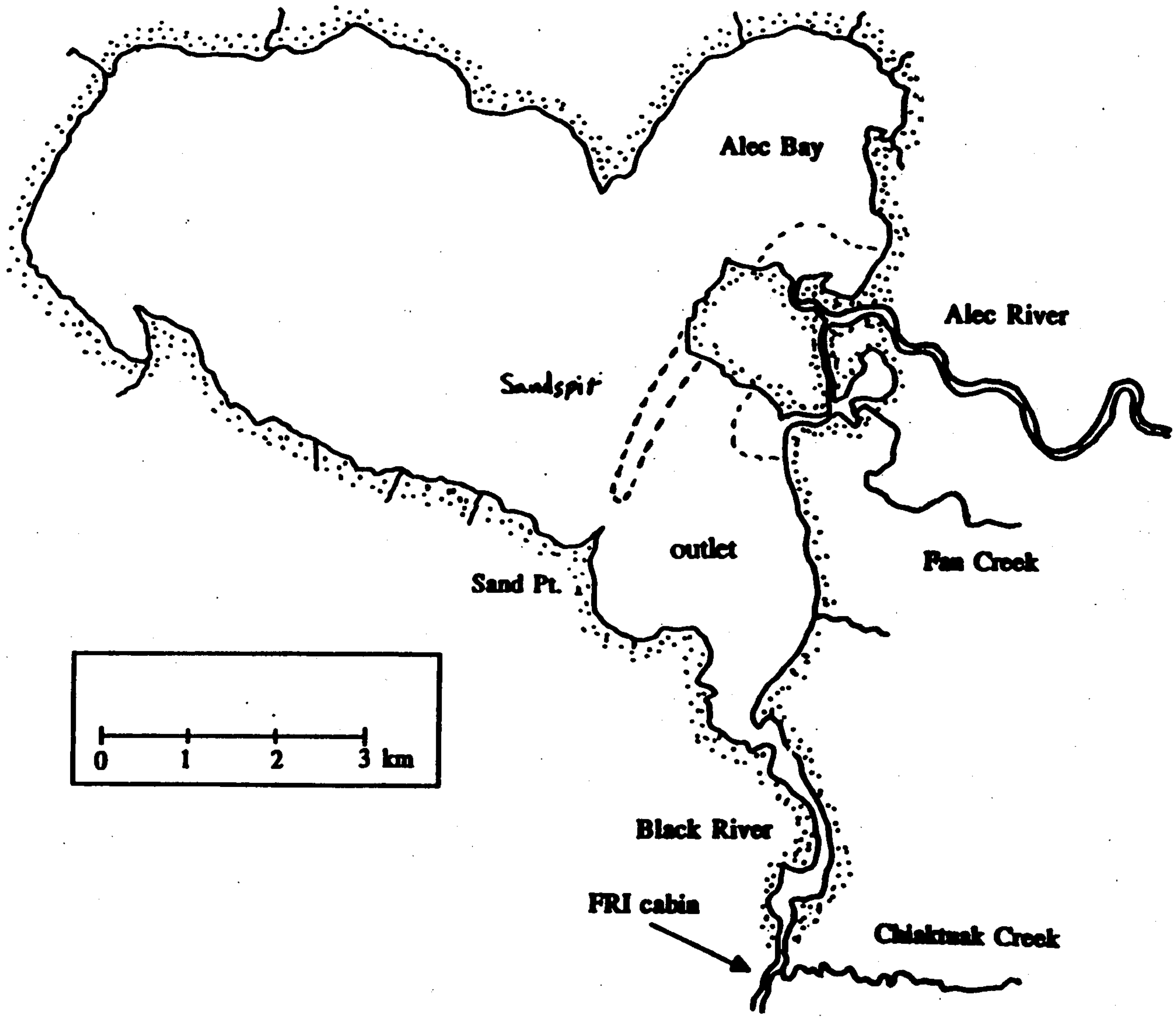


Figure 11. Black Lake in the Chignik Lake system. Note the channel connecting Alec River with the outlet area and the sand bar that separates the main lake from the outlet during low water (source: Ruggerone and Denman 1990).

Beavers did not even occur in the area as recently as the mid-1950s (Bricker 1977), and subsequently have expanded their range into the Chignik area. Beaver ponds occur on numerous sockeye spawning streams that feed Black Lake as well as on the Clark River, which flows into Chignik Lake. These ponds may be responsible for decreases in sockeye production by reducing spawning habitat through stream blockages or siltation of spawning areas. Specifically, beaver ponds reduce water flow to Black Lake, which is already shallow. The water loss in the ponded areas through transpiration and/or evaporation is sufficiently high is also a major concern. The effects of beaver ponds on sockeye production in the Chignik area need to be addressed.

Spawning Channels:

Artificial spawning channels are designed to increase and enhance natural spawning habitat through control of such factors as water flow (measured in cubic feet per second [cfs]), substrate, sedimentation, and predation and thereby increase the egg-to-fry survival rates. While the average egg-to-fry survival rates in a natural stream may be a little as from 10% to 15%, the introduction of spawning channels may increase those survival rates by as much as from 35% to 80%. Implementation of this technique requires a controllable water source, proper terrain, and sufficient brood stock to utilize the spawning channels. Because spawning habitat is not limited for sockeye salmon in the Chignik area, the application of this technique would be most promising for chum salmon.

Fishpassage Improvements:

The construction of a fishpass (fish ladder or steep pass) is a permanent form of habitat modification to enable fish to access spawning and rearing habitat beyond an impassable barrier such as the vertical face of a waterfall. This technique can be applied as either a constructed fish ladder (i.e., made of concrete, steel, or aluminum) to bypass a barrier or as an alteration of the barrier itself (e.g., through explosives to provide a series of ascending resting pools); however, their success will depend on an adequate preconstruction evaluation, including estimates of high- and low-water flows as well as the species and number of fish utilizing the system. Experience in these techniques over a broad range of conditions have allowed us to conclude that a well-placed fishpass will yield a high benefit-cost ratio.

Predator/Competitor Control:

These techniques address modifications of the biological habitat, rather than the physical one. The techniques involve attempts to improve various conditions for salmon stocks at any one or a number of different stages of their life cycle by taking direct action on species who prey on them or compete for their spawning habitat, food, or rearing area. Historically, projects have attempted to reduce populations of Dolly Varden char or sticklebacks from salmon streams. Resident fish in both Black and Chignik Lakes include threespine stickleback, ninespine stickleback, and pond smelt which are potential competitors for food. Historical information suggests that Black Lake supports a higher abundance of resident fish than Chignik lake, but interspecific competition for food may not be extreme because of divergence of food habits (Parr

1972). Ruggerone and Rogers (1992) identified predation by juvenile coho on sockeye salmon in Chignik Lake and identified an integrated harvest management strategy for coho and sockeye that would stabilize predation by juvenile coho on sockeye salmon fry. Present management of coho allow coho escapement to fluctuate depending on run size, whereas the sockeye escapement goal is fixed at 250,000 adults. Stabilization of the coho to sockeye spawning ratio could lead to enhanced runs of sockeye salmon, because from 1985 to 1987 coho were the major source of mortality for sockeye fry after they entered Chignik Lake (Ruggerone 1989, Ruggerone and Rogers 1992).

Limnological/Fisheries Investigations:

Sockeye salmon production in the Chignik River system was studied extensively in the late 1960s and early 1970's (Narver 1966; Dahlberg 1968 and 1973; Phinney 1968; Burgner *et al.* 1969; Parr 1972). Although pertinent information relative to sockeye production and lake productivity resulted from these studies, these data are over 20 years old and may not reflect current conditions.

Limnological investigations of general water-quality parameters, nutrients, phytoplankton, zooplankton, and fall fry were conducted in Chignik and Black lakes during 1991 to characterize lake productivity relative to juvenile sockeye salmon (*Oncorhynchus nerka*) production, historical information, and other sockeye nursery lakes. Kyle (1992) summarized all limnological and fisheries data collected in 1991. The following are sections from the report of Kyle (1992) that characterizes the productivity of these lakes.

Limited historical/comparable nutrient and water quality parameters are available to contrast with current data. However, the most striking differences between historical and current water sampling were the concentrations of nitrate nitrogen and phosphate phosphorus in both Chignik and Black lakes. Narver (1966) reported that nitrate N in Chignik Lake ranged from <6-32 μg/L and from <6-20 μg/L in Black Lake. Current sampling revealed nitrate N concentrations in Chignik Lake ranged between 76-126 μg/L and in Black Lake from the detection limit (3.4 μg/L) to 116 μg/L. Phosphate phosphorus from filtered samples collected in Chignik Lake during 1962 ranged from <6-50 μg/L and from <6-20 μg/L in Black Lake (Narver 1966). However, current sampling indicated total filtered phosphorus ranged from 2.7-6.1 μg/L in Chignik Lake and 1.5-5.2 μg/L in Black Lake.

The reported low concentrations of nitrate nitrogen in the 1960s would indicate a limiting factor for algal production; however, chlorophyll a concentrations reported in the 1960s were quite high consistently throughout the sampling season (Narver 1966). Thus, data from sampling in the 1960's suggest an underestimate of nitrate N concentrations. Conversely, concentrations of phosphate P was higher in the 1960s than current sampling, indicating a lowering of the input of phosphorus. However, the spring total phosphorus concentration in both lakes centered around 10 μg/L in 1991, which is the target concentration for optimum primary productivity in oligotrophic sockeye lakes of Alaska.

Although chlorophyll a levels in both lakes are less than those reported during the 1960's, the current concentrations are higher than average for other oligotrophic sockeye lakes in Alaska. In addition, phytoplankton (i.e. blue-greens) inedible to zooplankton in both lakes were low in composition ($<5\%$), while diatoms a food source for herbivorous zooplankton were abundant. The nutrient ratios were $>29:1$, which does not favor the production of unfavorable phytoplankton. In addition, as total phosphorus concentrations were not relatively low in either lake, the high N:P ratios indicate a slight excess of total nitrogen.

Stenson (1972, 1976) and Kerfoot (1975, 1977) found that when planktivorous salmonids (e.g., sockeye) are abundant, *Bosmina* spp. tend to be of small body sizes. Excessive planktivory by fish not only reduces prey size, but also structures zooplankton composition. For example, Brooks (1969) found that *Bosmina longirostris* was dominant in most ponds or lakes in North America and Eurasia where fish predation is intense. He concluded that in zooplankton communities faced with intense planktivore pressure, smaller-sized *Bosmina* prevail because they can continue to reproduce at an adult size less than 0.40 mm. In Chignik Lake, *Bosmina* body sizes ranged from 0.32-0.38 mm and averaged 0.35 mm, which is below the minimum threshold size (0.40 mm) for elective feeding by sockeye salmon fry (Koenings and McDaniel 1983; Kyle *et al.* 1988) and is indicative of intense predation. In addition, *Bosmina* densities ranged from approximately 2 to 5 times those of the larger-sized *Daphnia*. The seasonal mean density of *Bosmina* and *Daphnia* in 1991 was 78,357/m^2 and 42,623/m^2 respectively. Thus, 1991 sampling suggests that the zooplankton community of Chignik Lake resembles one that sustains predation pressure by juvenile sockeye in the form of a cladoceran composition dominated by *Bosmina* and the presence of small size *Bosmina*.

In Black Lake, *Daphnia* were not found and *Bosmina* comprised the majority of zooplankton. The average size of *Bosmina* was also under the minimum threshold size for elective consumption by sockeye fry, indicating intense predation pressure, and in addition, *Cyclops* and *Eurytemora* were much smaller than in Chignik Lake. The absence of *Daphnia* in Black Lake is not unique for turbid lakes as silt particles such as those found in glacial lakes do interfere with feeding and reproduction of cladocerans (Edmundson and Koenings 1985; Koenings *et al.* 1990). Nonetheless, because of the relatively low turbidity of Black Lake, especially in the early season (before August) and the relatively enriched conditions of this lake, we would have expected higher cladoceran densities and the presence of *Daphnia*.

In both lakes, particularly in Chignik Lake, the peak standing stock of zooplankton did not occur until later in the growing season (August), which could hinder growth and potentially survival of sockeye fry, especially young-of-the-year. The timing of peak forage production is critical to sockeye fry entering the limnetic area of sockeye nursery lakes, and has been suggested as a reason for the decline of Karluk Lake sockeye (Koenings and Burkett 1987).

The hydroacoustic estimate of 1.7 million juvenile sockeye rearing in Chignik Lake in September represents a low population based on euphotic volume, the standing stock of macrozooplankton, and escapement level. That is, based on an euphotic volume (EV) model (Koenings *et al.* 1989) of 158.9×10^6 m^3 (or 159 EV units), Chignik Lake would be forecasted to support a total of 5.2

million sockeye juveniles in the fall. In contrast, based on a seasonal macro-zooplankton biomass of 661 mg/m^2, Chignik Lake would be projected to produce 14.5 million threshold-size smolts (2.2 g) or 6.4 million optimum size (5.0 g) smolts (Koenings and Kyle 1991). Hindcasting the population of fall juveniles, assuming a 65% fall fry-to-smolt survival, indicates that for the projected number of threshold size smolts a total of 23 million juveniles would be rearing in the fall, and for optimum size smolts a total of 9.8 million fry would be rearing in the fall. In addition, the broodyear escapement in Chignik Lake from which the age-0 sockeye juveniles were produced was 335,867 (1990), and the age-1 juveniles were a product of the 1989 record-high escapement of 557,171. Thus, the fall population estimate of juvenile sockeye based on the hydroacoustic survey and townetting was well below the projected rearing capacity of Chignik Lake based on euphotic volume (Koenings *et al.* 1989) and standing stock of macrozooplankton (Koenings and Kyle 1991) and less than expected from the number of adult spawners. It is possible that a portion of the sockeye fry rearing in Chignik Lake during the hydroacoustic/townet survey was distributed such that they were not detected/represented by the survey equipment. However, even a doubling of the fall population estimate would still be a substantial underestimation of juvenile production based on euphotic volume and zooplankton biomass.

The size of age-0 sockeye fry collected from townetting in Chignik Lake during early September 1991 averaged 64 mm and 2.6 g. This compares with the 47-mm length of age-0 sockeye sampled in September of 1960 and 1961 (Burgner *et al.* 1969). The sizes of both age-0 and age-1 sockeye sampled in the fall of 1991 in Chignik Lake are moderate compared to other sockeye populations. In 1991, the average number of sticklebacks per 30-minute tow in Chignik Lake was 47. Although only three (15-minute) tows were conducted in 1991, in 1962 the weighted mean catch of sticklebacks (over the summer) per standard surface tow (6 minutes) was 3.8 (Burgner *et al.* 1969) or equivalent to 19 for a 30-minute tow, a 2.5-fold lower abundance of sticklebacks. Finally, there was evidence of size-selectivity within the zooplankton community (e.g., undersized *Bosmina*), which is characteristic of intense foraging. Thus, there could be some intraspecific competition for food among juvenile sockeye as well as interspecific competition from sticklebacks.

Lake Fertilization:

Sockeye salmon production in the Chignik system is dependent on the rearing environments of Black and Chignik Lakes. Historically, Chignik stocks have formed the bulk of the total run into the Chignik system. Black Lake is a shallow, turbid system that produces fry that are thought to overwinter in Chignik Lake and migrate as large age-1 smolts. Chignik Lake is a large, clear system that produces very small age-1 smolts. The existing pressure on the food base for resident Chignik fry, even without the added pressure from nonresident Black Lake fry, is evident from recent investigations. The geomorphological structure of Chignik Lake suggests a nutrient poor, unproductive environment for rearing fish, relative to that for Black Lake. The poor growth of Chignik fry is apparent by the minimal size of the smolts and the mass starvation of fry witnessed to occur at the lake in the past.

None of the water-quality parameters, nutrient concentrations or ratios, and phytoplankton data indicated any prominent limitation to productivity in either lake during 1991. The seasonal mean density of macrozooplankton in Chignik and Black lakes ranked seventh and sixteenth, respectively, compared with 25 other sockeye nursery lakes in Alaska. In 1991, sampling suggests that the zooplankton community of Chignik Lake resembles one that sustains predation pressure by juvenile sockeye in the form of a cladoceran composition dominated by *Bosmina* and the presence of small size *Bosmina*. These lake systems are not currently being considered for lake fertilization; however, there is concern of the intense predation on zooplankton occurring in Chignik Lake. With further data collection and analysis and consideration of the magnitude of fry rearing in Chignik Lake, a thorough review of escapement goals into both systems may be recommended.

Research/Management Techniques

Reevaluation of Sockeye Escapement Goals:

The existing escapement goals for sockeye salmon in Chignik and Black Lakes were developed in 1965 by FRI researchers who examined both the spawner/recruitment relationships from 1922 to 1964 and rearing capacity of the lakes (Narver 1966, Dahlberg 1968). These researchers recommended that the escapement goals be reexamined after a decade. The goal of this reevaluation is to maximize the sustained harvest of sockeyes from the Chignik system. To accomplish this goal, current and accurate brood tables are imperative. The Alaska Department of Fish and Game maintains age data by stock (i.e., Black or Chignik Lake) in brood tables as assigned by scale pattern analysis; these are published each year in the annual management report (AMR). Ruggerone (1989) has also published a brood table for these stocks.

Management of Sockeye and Coho Salmon After Weir Removal:

Sockeye salmon enter the Chignik River from early June until early October, and coho salmon enter the river from early August until mid-October. A weir is used to enumerate sockeye salmon escapement from early June until approximately mid-August, when the weir is removed. Although most of the Black Lake escapement is counted through the weir, a significant portion (i.e., about 20%) of the total sockeye salmon escapement to Chignik Lake and nearly 100% of the coho salmon entering the Chignik River are not enumerated during the season. These nonenumerated fish will be estimated during the season by modeling catch:escapement ratios or by using catch-per-unit effort models, such as those described by Ruggerone (1989). The data would be a useful reference for stabilizing the sockeye:coho escapement ratio, which is important because juvenile coho salmon are a major predator of juvenile sockeye salmon in Chignik Lake (Ruggerone 1989a, 1989b, 1989c; Ruggerone and Rogers 1992).

Other Enhancement Techniques

In-Stream Incubation Units:

The application of this technique involves use of a large container in which fertilized eggs and selected gravel (substrate) are placed in alternating layers. A plumbing system forces water up through the gravel. Such units control the water flow, substrate type, sedimentation, and predation to provide green-egg-to-fry survival rates as high as 90%. In-stream incubators are a low-cost enhancement technique that are ideally suited for small operations at remote sites. After artificial spawning of the brood stock and placing of eggs in the unit, minimal care is required. When they are used for enhancement of indigenous stocks, these units can eliminate the genetic and pathology concerns associated with transport of eggs or fry. To effectively apply this technique, the following prerequisites are needed: (1) high-quality water source, (2) adequate head (i.e., height differential to provide sufficient flow) without installing excessive length of piping, (3) suitable stream bottom, and (4) protected area for incubation units. These units can be used to bolster fry production independently or in combination with lake fertilization and fishpass projects.

Lake Stocking:

When a rearing area is a limiting factor in salmon production, there is a potential to further develop the production from the natural nursery areas. Some lakes (i.e., rearing habitat for chinook, coho, and sockeye salmon) are underutilized because there may be not enough fish returning to the system or access is blocked; however before this technique is applied, specific criteria need to be considered: (1) the lake must be located in an area that would facilitate harvesting the returning fish; (2) prestocking studies (e.g., limnological, predation, etc.) need to be initiated to determine suitability of lakes to ensure that planted fry would grow and survive until outmigrating to marine waters; and (3) stocking densities and timing need to be determined to optimize success.

Stream Stocking:

When streams have areas of underutilized habitat that can serve as natural rearing areas, a variety of stream stocking techniques may be helpful in rehabilitating declining populations of wild stocks. The various techniques follow: (1) after artificial spawning, green eggs are planted; (2) after artificial spawning and partial incubation, eyed eggs are planted; (3) after artificial spawning and incubation, unfed fry are released; (4) after artificial spawning, incubation, and partial rearing, fed fry are released; and (5) after artificial spawning, incubation, and rearing, smolts are released into the stream.

Hatcheries:

Hatchery facilities are generally eight times more efficient in converting eggs to juvenile fish than the natural environment. The efficiency of such production shortens the time involved in rehabilitating depleted stocks. Because of sizable initial capital investment, hatcheries may appear to be an expensive means of supplementing salmon production; also, the longer a hatchery holds fish, the more money it invests in each fish. This relationship is mitigated, however, by the improved survival of fish that have been more fully developed in the hatchery. Short-term rearing can double marine survivals and substantially increase hatchery feasibility. Because of the optimal productivity of the Chignik and Black Lake systems, this may not be perceived as a viable or necessary option for the region.

FIVE-YEAR ACTION PLAN

Sockeye Salmon Enhancement/Research Projects

The Chignik/Black Lake system's sockeye salmon resource is the most important species of salmon in the area. The resulting runs produced from these lakes not only support the Chignik area fisheries, they also significantly contribute to the salmon fisheries of the Kodiak and Alaska Peninsula management areas. Continued success of these two sockeye runs will depend on a better understanding of the carrying capacities of Black and Chignik Lakes. The upgrade and review of pertinent data derived from limnological/biological studies of these lakes will provide that understanding. This data, when combined with a review of escapement goals and stock identification, fry/smolt, and other pertinent studies and then incorporated into management strategies, should result in the achieving of a consistent and healthy production of sockeye salmon.

The purpose of this series of projects is to determine and implement the most cost effective and expeditious approach to restoring and/or maximizing the productive capacity and economic value of Black Lake. There are a wide range of opinions regarding the best approach because of the lack of basic information. These following series of projects have been defined so that a four-step process can be implemented as rapidly as practicable: (1) survey, (2) feasibility, (3) design, and (4) construction.

Black Lake Site Reconnaissance and Hydraulic Assessment Survey:

The purpose of this project is to provide all relevant information regarding the specifics of the site to establish the parameters within which a solution may be devised. This project has been contracted to CH2MHill, and the majority of the field work will be conducted in May, lab work in June and July, and any needed follow-up field work in July or August, 1993. The results of this project will be widely circulated so that a consensus approach may be facilitated as a part of the next project.

Objective. To determine the physical factors that are controlling the present hydraulic conditions at the mouth of the Alec River and at the outlet of Black Lake.

Jobs.

1. Survey and prepare a topographic map (depth profile, plan-form, and representative sections) of (a) the Alec River from the bend located upstream from the channel split to approximately one-half mile downstream in both channels and (b) the outlet of Black Lake for approximately one mile downstream. The focus will be on the locations and relative elevations of the stream thalweg (i.e., the line of continuous maximum descent), bank edges, sand bars, stream bed slopes, and especially hydraulic controls such as riffles and channel constrictions.

2. Collect sediment samples from representative sand bars, hydraulic control riffles, and stream banks to determine erodibility.

3. Observe vegetation growth, debris accumulation limits, and other physical evidence of the dynamic history of the Alec River delta and Black Lake outlet.

4. Review and assess aerial photographs of the river and lake.

5. Meet with local residents to discuss lake history.

6. Subsequent analysis of the site data will include developing estimates of seasonal stream discharge rates, determining the energy grade line for the stream, identifying flow constrictions and hydraulic control elevations, and estimating sediment transport rates, including erosional and depositional trends. This data will serve as the basis for selecting and refining feasible approaches that might be used in restoring elevation stability in Black Lake.

Black Lake Inlet and Outlet Control Concept Feasibility:

In the Alec River during lower water flows, 70% of the volume of water is discharged to the lake outlet at Black River. This phenomenon raises the question of whether sockeye fry are moving prematurely down into Chignik Lake. Investigations need to be initiated to determine the biology and mechanics (hydrology) of this system. Moreover as more of a silt load is dumped into Black Lake, causing the water temperatures to fluctuate dramatically because of its shallowness and because its dark substrate absorbs heat, studies need to be conducted on the heat tolerance of sockeye fry.

The purpose of this project is to evaluate all data and formulate an integrated solution that (a) has significant probability of success (b) is affordable, (c) has no undesirable environmental side effects, (d) is reversible should the desired effect not be obtained, and (e) provides the basis for the permitting process. This definition and scope of this project will be expanded upon completion of the survey and CRAA staff will make specific recommendations for implementation to the Executive Committee and/or Board of Directors so that this project maybe completed by early Fall.

<u>Objective.</u> To establish a feasible concept for an integrated solution to control the inlet and outlet of Black Lake.

<u>Jobs.</u>

1. Develop a sediment control concept and/or fry diversion concept for the Alec River delta.

2. Develop an elevation control concept for the Black Lake outlet.

3. Initiate permitting process.

Black Lake Inlet and Outlet Control Plan Design:

This project will be contracted for the late fall of 1993 and early winter of 1994 so that detailed engineering plans will be ready for implementation in 1994.

Objective. To provide blue prints and cost estimates for the construction of the selected concept during 1994 or as early as practicable.

Jobs.

1. Prepare a detailed design and construction plan for the sediment control system and/or fry diversion structure for potential vendors.

2. Prepare a detailed design and construction plan for the sill/weir/hydroacoustic structure for potential vendors.

3. Oversee the installation of system(s).

Aerial Photography:

The purpose of this project is to provide the necessary aerial photography to all other projects without duplicating efforts. Photographs are needed for the three objectives identified below. Aeromap US has been contracted for Job No. 2, the "quantitative survey." CRAA will solicit the use of a small plane from the membership with minimal associated costs. ADF&G has agreed to add Job No. 4 to their normal spring flight schedule without incurring any costs.

Objectives. (1) To provide conventional color photographs of Alec River and all Black Lake tributaries in May to map the location and quantify the surface area of beaver ponds and vegetation types in the riparian zone; (2) to locate potential obstructions for migrating salmon, primarily sockeye, in all major tributaries; and (3) to provide infrared and conventional photographs in May of the Alec River Delta and Upper Black River to allow geomorphic and hydraulic description of the engineering project site (to include flood conditions).

Jobs.

1. Provide duplicate copies of CLEST photographs.

2. Take quantifiable infrared and conventional photographs at varying resolutions (as needed for the beaver colonization and Black Lake survey projects) from high wing aircraft of the Chignik watershed during May.

3. Conduct qualitative aerial surveys of all rivers during September to observe the effects of specific beaver dam blockages identified in Job No. 1 and expand the coverage to include smaller tributaries.

4. Conduct qualitative aerial surveys of smaller coastal streams (such as Portage Creek) to search for and document any blockages during May.

Effects of Beaver Colonization:

The purpose of this project is to provide information to CRAA and other decision makers sufficient to determine the impact on sockeye salmon production of relatively recent beaver colonization in the Chignik area. The results of hydrology efforts will contribute to determining the most cost effective and expeditious approach to restoring and/or maximizing the productive capacity and economic value of Black Lake. CRAA, with financial assistance from the Lake and Peninsula Borough, has contracted the hydrology work in the Black Lake drainage to Natural Resource Consultants. This project, together with the aerial photography project will also lay the ground work for the Chignik Lake Enhancement Study Team to fund and manage efforts to mitigate and/or ameliorate the beaver dam's negative impact on the migration and spawning habitat of sockeye salmon. The Chignik Lake Enhancement Study Team will prepare a proposal by May 15 for this project and hopes to begin this project by fall 1993.

Objectives. (1) To determine whether beaver colonization in Black Lake drainage has reduced water flowing into in Black Lake sufficient to lower the lake level and/or negatively impact the migration/spawning habitat of sockeye salmon; (2) to determine if flow fluctuation during May and June in the Alec River has been moderated sufficiently by beaver colonization in the Alec River drainage to cause an increase in sockeye salmon fry diversion into the side channel that enters the outlet of Black Lake; and (3) to provide data sufficient to make quantitative estimates of the effects on the hydrology and resultant fry migration patterns of removing beaver dams for the purpose of completing a detailed design and construction plan for a sediment control structure or method, a fry diversion structure, and/or an outlet sill/weir structure.

Jobs.

1. Conduct literature survey on transpiration rates for vegetation in the Black Lake drainage.

2. Map beaver pond locations and determine pond surface area and depth.

3. Estimate water loss associated with beaver ponds.

4. Verify estimates of water loss associated with beaver ponds with a field survey.

5. Quantitatively asses the effect of beaver ponds on flow fluctuations in Alec River.

6. Coordinate and participate in qualitative aerial survey for blocked beaver dams.

7. Establish a gaging station in the Alec River above the split (i.e., new and old channels).

8. Provide written reports and maps.

Continuing Sockeye Salmon Studies/Research Projects

The continuing studies and research projects are composed of the following: Winter Study, Alec River Fry Emigration, Fry Biology, Smolt Enumeration and Sampling, Basic Limnology, Hydrology, and General Continuing Studies. The Fisheries Research Institute has been contracted to conduct the General Continuing Studies and provide field assistance on the other projects. Natural Resource Consultants has been contracted for the other projects and to coordinate with other projects in the field. These studies are directed at providing information regarding the life history of Chignik sockeye salmon that will provide for long-term monitoring of the resource and measuring the effects of enhancement and rehabilitation efforts. Each project has specific objectives in this regard.

Winter Study:

The winter study has been completed (i.e., winter 1992/1993) and a report is being prepared.

Objective. To investigate the winter carrying capacity and winter sockeye utilization of Black Lake.

Jobs.

1. Take hydrolab measurement of dissolved oxygen, water depth, and temperature from February through ice-out.

2. Map horizontal and vertical distribution of dissolved oxygen, correlate with hydrolab, and compare data with those for 1990 and 1992.

3. Determine whether sockeye overwinter in Black Lake.

4. Experimentally determine sockeye tolerance to short-term, low levels of dissolved oxygen.

5. Record lake level and calculate volume of usable sockeye habitat.

6. Estimate the biochemical oxygen demand of sediment and estimate standing crop of phytoplankton.

7. Measure light level beneath the ice in order to assess whether photosynthesis is producing oxygen.

8. Establish hypothesis for the mechanics for winter redistribution of water in Black Lake

Alec River Fry Emigration:

Objective. To validate that the distribution of emerging sockeye fry entering Black Lake is dependent on relative flow in the "old" versus "new" side channels of Alec River and whether changes in the distribution of flow from Alec River could result in large numbers of sockeye prematurely leaving the productive rearing environment of Black Lake.

Jobs.

1. Measure water velocity in the Alec River (and add data to existing data set) and compare these measurements to critical swimming speeds reported in the literature for juvenile salmon. This comparison will be used to demonstrate that the distribution of sockeye entering Black Lake is primarily determined by the distribution of flow entering the lake.

2. Measure percentage of flow in the side channel of Alec River as a function of total discharge (data to be added to existing data set).

3. Estimate relative percentage of emigrating fry in Black River that originated from the old channel versus side channel of Alec River. Emigrating fry in Alec River will be captured and several fluorescent dyes will be used to differentially mark large numbers of fry in Alec Bay and the lake outlet. Marked fry will be recaptured in Black River. These data will indicate the probability of fry emigrating from Black Lake relative to their initial point of entry; i.e., Alec Bay or the outlet.

3. Genetic analysis of sockeye fry residing in Black Lake versus those emigrating to Chignik Lake.

Fry Biology:

Objective. To determine the nature and extent of sockeye fry utilization of Black Lake and Chignik Lake.

Jobs.

1. Enumerate emigrating sockeye fry in Black River using rotary traps, fyke nets, and mark-recapture techniques to determine abundance and timing of migration and whether sockeye typically overwinter in Black Lake, (although it has been generally assumed that most sockeye remain in Black Lake). Correlate daily abundance of fry with water temperature, water level, and wind-induced turbidity in the outlet area.

2. Quantify upstream migration of sockeye fry and other fishes in the upper Black River. Traps will be set along the shoreline of Black River both above and below Chiaktuak Creek and monitored several times per day.

3. Townet in early September in Chignik and Black Lakes to examine numbers of sockeye remaining in Black Lake before winter by examining length at age and use length at age to identify lake of origin, if possible. Sockeye catch rates and fish lengths will be compared with those during the 1960s and 1992. Stomach contents will also be examined.

4. Examine otoliths of fry reared in net pens for daily growth rings and determine the feasibility of estimating relative growth rates in Black and Chignik Lakes. Use the data collected together with a bioenergetics model and literature values to compare growth and feeding rates of sockeye fry in Black Lake and Chignik Lake

Smolt Enumeration and Sampling:

Objectives. (1) To determine the production of smolts for both Black Lake and Chignik Lake; (2) to determine the relative component of those smolts having reared in Chignik Lake that were initially produced by Alec River and to compare this estimate against historic indicators where possible; and (3) to establish an index and associated sampling plan for smolt abundance, size, and age data that is sufficiently accurate and consistent between years so that it can be used for forecasting and monitoring the conditions of the rearing environment.

Jobs.

1. Select a site for two medium rotary screw traps in Chignik River and Black River and deploy, operate, and maintain these traps from May through June.

2. Determine length and age of sockeye salmon smolts during the sampling season and use these data to identify the percentage of sockeye that originated in Black Lake but reared in Chignik Lake during the previous summer.

3. Estimate abundance using mark-recapture techniques.

4. Examine historical smolt data (length frequency data from the 1950s, if available) to determine the contribution of sockeye that originated in Black Lake but reared in Chignik Lake during the previous summer.

5. Apply smolt abundance estimates to a range of assumed marine survival rates to examine potential adult returns and the validity of smolt abundance estimates.

Basic Hydrology:

Objective. To monitor the hydraulic conditions of Black Lake throughout the summer and fall to support projects.

Jobs.

1. Measure lake level and use the detailed depth contour map of Black Lake developed in 1992 to monitor changes in water volume and sockeye habitat.

2. Establish a gaging station in Black River (of the same type as the station established in Alec River for the beaver study) and develop a rating curve.

3. Continue to monitor bank erosion in the Alec River side channel using stakes placed at several points of erosion during previous years.

4. Monitor river height throughout the field season at gaging stations in the main stem of Alec River and in Black River and in each channel of the Alec River using staff gages installed by CH2MHill in May.

Limnology:

Objectives. (1) to estimate the carrying capacity of Black Lake during summer and fall and (2) to predict the outcome on carrying capacity of an increased water level of Black Lake.

Jobs.

1. Retrieve hydrolab and thermographs deployed during February 1993 and download data.

2. Redeploy thermograph to obtain data on rate of temperature changes and redeploy hydrolab to obtain daily and seasonal (February-May) changes in dissolved oxygen as well as other parameters.

3. Enumerate zooplankton in Black and Chignik Lakes once per month from May through September. Duplicate 40-m horizontal tows will be made at three stations in Black Lake; two vertical hauls will be made at each of two stations in Chignik Lake; and secchi depth will also be recorded.

4. Collect water samples for chlorophyll determination at the above stations and times.

5. Examine water transparency in Alec Bay and at the outlet of Black Lake. Secchi depths will be measured opportunistically during calm periods in order to establish baseline conditions prior to the rediversion of Alec River back to Alec Bay.

6. Evaluate the production potential or carrying capacity of Black and Chignik Lakes using the relationship developed by ADF&G.

Determination of Enhancement Potentials for Sockeyes Salmon Lakes from Stable Isotope Ratios:

The annual sockeye salmon escapement to a river/lake system injects a certain amount of nutrients into that system in addition to what is coming from terrestrial sources. Since salmon carcasses contain marine nitrogen, which is isotopically different from terrestrial nitrogen, the importance of the former source can be identified by stable isotope ratios. This project proposes to refine this process for general use throughout the region. The stable isotope ratios will be used to determine how marine nitrogen glows through the systems and especially determine if nutrient levels further warrant fertilization.

Objective. (1) To develop a technique for measuring marine nitrogen contribution to various components of the food chain in Chignik Lake and (2) to determine successful lake fertilization candidates.

Jobs. Yet to be determined.

General Continuing Studies:

Objective. To provide academic oversight, management investigations, and discretionary tasks related to salmon production and management.

Jobs.

1. Monitor emerging fry rates in Chignik Lake.

2. Monitor species composition and sizes in Chignik Lake with beach seines and in Black Lake with the fall townet samples.

3. Maintain sockeye brood tables.

4. Make sockeye forecasts.

5. Collect tissue samples from adults returning to Black Lake, Chignik Lake, and Chiaktuak Creek to determine genetic variability between stocks and within stocks (as a function of run timing).

Sockeye Salmon Management/Research Projects

Reevaluation of Escapement Goals:

Sockeye salmon production in the Chignik system was studied extensively in the late 1960s and 1970s. These data are now over 20 years old. This project would use either limnological or return-per-spawner data in Black and Chignik Lakes to evaluate and adjust escapement goals

Objective. To determine the most efficient harvest management strategy.

Jobs.

1. Consolidate data and reexamine sockeye salmon escapement goals and forecast methodology.

Existing Chignik River Weir:

This weir is the most important tool that is utilized in the management of the Chignik/Black Lake system's returning sockeye salmon; it enables managers to accurately access the numbers of salmon escaping upriver to spawn. Commercial fishing is not allowed until interim escapement goals have been reached. The data derived from weir counts are essential in assisting in the determination of the spawners in each run; i.e., Chignik Lake and Black Lake returns. It is important to investigate the possibility of maintaining the weir through the fall so that a more complete set of escapement data for both coho and sockeye salmon could be obtained. The technique of counting fish 10 minutes/hour at the weir gate and on that basis estimating the count for the rest of the hour has been reevaluated; the resulting determination is that under normal conditions it is sufficiently accurate for estimating the total escapement of sockeye salmon into the system.

Objective. To further increase the accuracy of weir count data where practicable.

Jobs.

1. Extend removal date of weir.

2. Maintain manpower at weir through the fall.

Sonar Feasibility:

Although the Chignik River weir is an accurate tool for enumerating the salmon moving into the system, its construction and maintenance is time consuming and labor intensive. The weir is also susceptible to washing out during high-water conditions, when salmon escapement cannot be enumerated. This can be costly to the fishing industry because of lost fishing time and possible overescapement. Department staff are also unable to leave the weir in place beyond

August 10 because of limited funding as well as the high-water conditions encountered in the fall. After the weir has been removed, escapement estimates are based on fishing performance in Chignik Lagoon; unfortunately, these estimates potentially have a high degree of error.

When a weir is not feasible, sonar technology could provide an accurate estimate of the total escapement, increase in-season management precision, and allow for testing of assumptions used by biologists to determine the final post-season run estimates. This technology would be ideally suited for implementation in the Black River, which drains Black Lake. A sonar counter at the Chignik River weir site could additionally provide a reliable back-up method in the event a portion of the weir is removed by flood conditions, similar to those occurring in 1986 and 1988. The success of this technology in other systems in Alaska warrants further investigation as to its feasibility in the Chignik/Black Lake system.

CRAA has solicited the opinion of Precision Acoustic Systems (PAS) and anticipates bringing their chief scientist into the field to obtain an objective opinion of the feasibility of using sonar to assist in the escapement enumeration process. PAS has developed proprietary technology that is currently being field tested by the Corps of Engineers. The results of these tests and the qualified opinions of PAS will also be considered in the design of any sill or weir structure at the outlet of Black Lake so that design can accommodate the most efficient use of this new sonar technology where practicable.

Objectives. (1) To obtain an expert opinion on the applicability of escapement enumeration techniques at Chignik Weir or other appropriate site using the latest sonar technologies; (2) incorporate results of feasibility studies into the design of any sill or weir structure at the outlet of Black Lake so that design can accommodate the most efficient use of sonar technology where practicable; and (3) coordinate this applied technology with Corps of Engineers, who have field tested sonar technology.

Jobs.

1. Characterize site profiles for sill/weir structure.

2. Investigate fitting the existing weir to extend the sampling period and/or increase accuracy.

3. Recommend configuration(s) for potential vendors.

Stock Identification Studies:

Sockeyes returning to the Chignik Lakes system have been historically divided into two stocks-- one returning to Black Lake (early run) and the other to Chignik Lake (late run). Smaller substocks mix within these two major groupings. Sockeye escapement goals for Black Lake and Chignik Lake stocks are 400,000 and 250,000 fish, respectively. Based on the premise that threshold escapement levels for each run can be achieved by a specific date, commercial fishing time for sockeye salmon has been regulated. Monitoring escapement with respect to achieving these thresholds is complicated by an overlap of the timing for the early and late runs; i.e., the transition period, which generally occurs during the latter part of June through mid-July.

Two methods have been developed to estimate the daily proportions accountable to each run during the transition period. The first is based on tagging studies conducted from 1962 to 1966 (Dahlberg 1968), which allowed biologists to develop an average time of entry (ATOE) curve to apportion the Chignik sockeye salmon runs into the early and late components. A form of this method is currently used for in-season management of the fishery. The second method is based on differential growths of juvenile salmon rearing in Black Lake, compared with those rearing in Chignik Lake (Burgner and Marshall 1974, Conrad 1983). Sockeye fry rearing in Black Lake emerge earlier and grow at a faster rate than fry rearing in Chignik Lake (Narver 1966). The disparity in growth rates of fry rearing in Black Lake and Chignik Lake is reflected by their scale patterns--when they are measured (i.e., scale pattern analysis [SPA]), they provide the variables used to separate Black Lake and Chignik Lake stocks. Postseason SPA is preferably used instead of the ATOE curve for the final postseason allocations of fish to either the early or late runs. Continued research into refining methods of separating the two runs is essential for the continuing improvement of management and production of the systems sockeye salmon. Further age structure, run timing, and scale pattern studies would also help determine sockeye salmon origins in the Shumagin Islands and in the Westward/Perryville management districts.

<u>Objectives.</u> (1) To determine the contribution of sockeye salmon of Chignik origin in the interception fisheries in order to contribute to the reevaluation of escapement goals for the Chignik stock; (2) to determine harvest rates on genetically distinct components of the Chignik/Black Lake stock complex with particular attention to the latter portion of the run; and (3) to provide information to the decision and policy makers regarding the interception rates of sockeye salmon of Chignik origin in these mixed-stock fisheries.

<u>Jobs.</u>

1. Collect tissue samples from escapement samples during the fall to establish baseline genetic data throughout the Chignik watershed.

2. Yet to be determined.

<u>Coho Salmon Projects</u>

Aerial Systems Investigation:

<u>Objective.</u> To acquire a comprehensive understanding of the run strength and harvest potential of regional coho stocks.

__Jobs.__ During a three-year study period determine, catalogue, and inventory major coho systems in region through aerial-survey techniques, particularly Port Wrangell, Long Beach, Aniakchak River, Foot Bay and Amber Bay.

Habitat Modification/ Coastal Stream Clearance:

__Objective.__ To remove blockages (i.e., logs, boulders, tidal debris) from streams or provide alternate means of providing fish access to systems blocked by impassable barriers.

__Jobs.__

1. Gather information on potential blockage sites.

2. Review of aerial photos from ADF&G for potential sources of blockage.

3. Remove significant blockages from these smaller streams where permitting is not necessary.

4. Earmark blockages needing permits for removal next year or determine alternate means of circumventing blockage.

5. Initiate permitting process, if necessary.

Recreational Opportunities:

__Objective.__ To determine the recreational fishery potential in the Chignik system.

__Jobs.__

1. Review aerial survey data and determine systems best suited for supporting such a fishery.

2. Conduct community surveys.

__**Pink and Chum Salmon Projects**__

Regionally, in terms of effort that should be directed toward increasing production, chum and pink salmon have been ranked a respective No. 3 and No. 5 (lowest priority) in the region. The lowest priority given to pinks was based on historical commercial harvests trends as well as the more recent 1991 decline in their marketability.

Habitat Modification/Coastal Stream Clearance:

Information has been provided by Mike Gruner regarding potential blockage sites. These sights will be flown over by ADF&G and the resulting photos will be used to solicit contracts to remove these blockages as rapidly as possible.

__Objective.__ To remove blockages (i.e., logs, boulders, tidal debris) from streams that do not require a permit during the summer of 1993 or provide alternate means for salmon access to systems blocked by impassable barriers.

__Jobs.__

1. Gather information on potential blockage sites.

2. Review of aerial photos from ADF&G for potential sources of blockage.

3. Remove any significant blockage from these smaller streams.

4. Earmark blockages needing permits for removal next year or alternate means of circumventing blockage.

Chum Salmon Instream Incubation Boxes or Spawning Channels Investigations:

__Objective.__ To increase production in those systems that are spawning limited.

__Jobs.__

1. Identify spawning-limited systems in the region.

2. Conduct follow-up studies to determine which of the two techniques would be most suitable and cost effective.

CONTINUATION AND IMPLEMENTATION OF THE PLAN

The Regional Planning Team's Role

Alaska statutes specify three functions of the Regional Planning Team: (1) development of a comprehensive salmon plan, including provisions for both public and private nonprofit hatchery systems (AS 16.10.375); (2) review of private nonprofit hatchery permit applications/project proposals (AS 16.10.400 [a]); and (3) review of the proposed suspension or revocation of a permit (AS 16.10.430). The remainder of this chapter provides a further elaboration on the responsibilities identified above and also a description of the annual updating process.

Ongoing Planning

Alaska Statute 16.10.375 provides the CRPT with the responsibility for development of a comprehensive salmon plan. Plan development is a constantly evolving process, as opposed to one that is fixed or static. This nature of the planning process gives CRPT a continuing role in salmon rehabilitation and enhancement planning. The CRPT is responsible for relating actual events to the plan and making the plan responsive to new knowledge, ideas, and changing conditions. Opportunities have thus far been presented within a 5-year time-frame. Numerous unknowns surround many of these opportunities, and some will never become actual projects. As projects in the Five-Year Action Plan become implemented or are determined to be infeasible or undesirable, they will be replaced with new projects for the upcoming five years.

The 5-Year Action Plan will be revised as necessary, and a procedure for its periodic update will allow for revision of certain sections. At times, new information and events will require the reevaluation of goals, objectives, area and site-specific targets, or assumptions used for planning.

Updating Process

The comprehensive salmon plan is designed to be a working document that provides a framework for increasing salmon production for the Chignik area; therefore, it will be periodically updated and submitted to the Commissioner of ADF&G. To maintain these updates, the CRPT will meet at least once a year to discuss (1) reports on current projects; (2) new projects under consideration; and (3) new opportunities that may be investigated as potential future projects. A statement of progress toward achievement of the goals and objectives in the plan and a project status report will be incorporated into the periodic report. Over time, this periodic report will reflect achievement the goals and objectives of the plan.

Criteria for RPT Review of PNP Hatchery Permit Applications/ Proposed Projects

Alaska Statute 16.10.400(a) provides that a hatchery application or project proposal must be at least evaluated in the context of its compatibility with the comprehensive salmon plan by the RPT, as well as criteria established by current regulations and statutes. AS 16.10.400(g) identifies conditions that must be satisfied if permits are to be issued by the Commissioner before the regional comprehensive salmon plan is complete. Part (f) of the same law requires that the commissioner shall classify a stream as suitable for enhancement purposes prior to a permit being issued.

There are approximately 100 anadromous streams in the Chignik area, and the process of evaluating one to determine whether or not it would be suitable for enhancement is very complicated, time consuming, and expensive. To accomplish a full inventory and classification of all the anadromous streams in the Chignik area is therefore beyond the financial and temporal limits of the plan. Instead, the RPT decided to formally make recommendations to the Commissioner at the time the department initiates the RPT review of a project for rehabilitation or enhancement of the fisheries. Accordingly, criteria are provided in Appendix A that are consistent with the language and mandate provided in AS 16.10.400(a), (f), (g). In reviewing and making recommendations to the Commissioner on nonprofit hatchery permit applications, the RPT will consider the following criteria in their review; this criteria will also be used, to the extent practicable, in their review of other rehabilitation and enhancement project proposals.

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LIST OF TERMS

ADF&G - Alaska Department of Fish and Game

alevins - Newly hatched fish on which the yolk-sac is still apparent.

allocation - To apportion, through regulation, salmon harvest to various user groups (i.e., subsistence, sport, or commercial fishermen).

anadromous - Fish such as salmon that are born in fresh water, migrate and feed at sea, and return to fresh water to spawn.

aquaculture - Culture of husbandry of salmon (or other aquatic fauna/flora).

benthic - bottom-dwelling fish such as halibut and rockfish.

biomass - The combined weight of a group of organisms; for example, a school of herring.

brood stock - Salmon contributing eggs and milt for supplemental culture purposes.

coded wire tag - Magnetically detectable pin-head sized tag implanted in the nose of a young fish for identification as an adult.

commissioner - Principal executive officer of the Alaska Department of Fish and Game.

commissioner approval - Formal acceptance of a salmon development plan or other RPT products by the Commissioner.

comprehensive salmon production plan - A statutory-mandated, strategic plan, spanning 20 years, for perpetuation and increase of salmon resources on a regional basis.

CRAA - Chignik Regional Aquaculture Association

criteria - Accepted measures or rules for evaluation of program and project proposals and operations.

CRPT - Chignik Regional Planning Team

CSA - Chignik Seiners Association

depressed stock - A stock which is currently producing at levels far below its historical levels.

enhancement - Strategy designed to supplement the harvest of naturally produced salmon species by using artificial or semi-artificial production systems or to increase the amount of productive natural habitat. Procedures applied to a salmon stock to supplement the numbers of harvestable fish to a level beyond what could be naturally produced. This can be accomplished by artificial or semi-artificial production systems. It can also be an increase of the amount of productive habitat in the natural environment through physical or chemical changes.

escapement - Salmon which pass through the fisheries to return upstream to a spawning ground or used as brood stock in a hatchery.

ex-vessel value - Price paid to the commercial fishermen for their catch.

eyed egg - The stage in which the eyes of the embryo become visible.

fecundity - The number of eggs per adult female salmon (or other fish).

fingerling - The stage of salmon life between fry and smolt.

fishery - The legally sanctioned harvesting of a particular species in a specific time and place; for example, the Chignik Lagoon sockeye salmon fishery.

fishpass - A fish ladder to enable salmon to get past a barrier to reach spawning grounds.

five-year action plan - The section of phase II planning that recommends projects for implementation within the next five years.

FRED - Division of Fisheries Rehabilitation, Enhancement and Development, Alaska Department of Fish and Game.

fry - The stage of salmon life from emergence from gravel until it doubles its emergence weight.

goals - Broad statements of what a planning team, with input from the user groups, hopes to see accomplished within a specified period of time.

green egg - The stage of salmon egg development from ovulation until the eye becomes visible, at which time it becomes an eyed egg.

hatchery - Facility in which people collect, fertilize, incubate, and rear fish.

incidental catch - Harvest of a salmon species other than the desired species from which the fishery is managed. Fish of another species and/or stock caught during harvest of specific species and/or stock.

instream incubator - A device, located adjacent to a stream, that collects water from the stream and is used to incubate and hatch salmon or trout eggs.

mixed stock fishery - Harvest of salmon at a location and time during which several stocks are intermingled. Harvest of more than one stock at a given location and/or period.

natural production - Salmon which spawn, hatch, and rear without human intervention (i.e., in a natural stream environment).

otolith - calcified ear bones of fish, otiliths offer future environmental marking promise. Manipulation of water temperature can produce distinctive otolith banding patterns in juvenile salmon, and these patterns can be used to identify specific groups of hatchery fish or differentiate between hatchery and wild fish stocks.

pelagic - Pertaining to the open ocean as opposed to waters close to shore.

pot - A box-like or conical trap covered with mesh for catching fish or shellfish.

plan development - Composing, drafting, revising, and finalizing a planning document.

PNP - Private nonprofit: level and/or operational status of a private sector organization without profit motives.

present condition - the average catch for the last five years.

private nonprofit hatchery permit application - A request presented by a private nonprofit corporation to the Department of Fish and Game for a permit to operate a private nonprofit hatchery.

private sector - That group active in salmon resource development which is not employed by government.

production - Perpetuation or increase of the salmon resource through maintenance, rehabilitation, or enhancement programs and techniques.

project - A unit of work having a beginning, middle, and end that functions according to defined performance criteria.

projected status - Continuation of the present condition without additional supplemental production.

public sector - That group active in salmon resource development that is employed by government.

recruitment - The upcoming or next generation of fish.

regional aquaculture association (RAA) - A statutory-based nonprofit corporation comprised of representatives of fisheries user groups organized for the purpose of producing salmon.

regional planning team (RPT) - A statutory-mandated planning group, composed of ADF&G staff and regional aquaculture association representatives, designated to develop a comprehensive salmon plan.

rehabilitation - Procedures applied to a depressed natural stock that increase it to historical abundance. A strategy directed towards restoring depressed natural stocks to previous levels of production.

restoration - Increasing the annual harvest of salmon to historic levels using management, habitat protection, enhancement, and rehabilitation strategies.

review and comment process - A collection of accepted procedures to solicit and generate examination and remarks.

revised plan - A document resulting from incorporation of commissioner-approved material into a plan.

roe - The eggs of a fish.

run - Returning salmon stock(s) bound for its spawning area which is often further described by its timing and numbers.

run strength - Total run of salmon, including escapement, plus harvest.

salmon:

chinook (king) - Oncorhynchus tshawytscha

Chum (dog) - Oncorhynchus keta

Coho (silver) - Oncorhynchus kisutch

Pink (humpy or humpback) - Oncorhynchus gorbuscha

Sockeye (red) - Oncorhynchus nerka

salmon stock - A population of salmon identified with a specific water system, or portion thereof. Salmon of a single species that are produced from a single geographic location and are of the same genetic origin.

seine (purse) - A long net that is drawn through the water encircling fish in its path; the bottom of the net is eventually closed and the captured fish brailed into the boat's fish hold.

smolt - A salmon, trout, or char which has passed through the physiological process of becoming ready to migrate to salt water.

sonar - Technology that uses sound waves in water to detect submerged objects such as schools of fish.

supplemental production - Salmon produced by method other than natural spawning using enhancement and/or rehabilitation methods.

spawn - (verb) To produce or deposit eggs; (noun) A mass of spawned eggs.

stock - A group of fish that can be distinguished by their distinct location and time of spawning.

terminal fishery - An area where a terminal fishery harvest could be conducted.

total run (run strength) - Number of salmon returning in a year for a stock or area (escapement plus harvest number).

uniform procedures - Those practices that have been accepted by planning participants as appropriate for conducting or accomplishing a task.

user group - Identification by method and/or reason for the harvest of salmon (commercial, sport, or subsistence).

weir - A fence, dam, or other device by which the stream migrations of salmon (or other fish) may be stopped or funnelled through for enumeration or holding purposes.

wild stock - Any stock of salmon which spawns naturally in a natural environment and is not subjected to man-made practices pertaining to egg deposition, incubation, or rearing. Stocks which have not been rehabilitated or enhanced.

zooplankton - Free swimming, drifting, or floating organisms, mostly microscopic in size, which are found primarily in open water and are an important source of food for small fish.

APPENDIX A

REGIONAL PLANNING TEAM REVIEW CRITERIA FOR PNP HATCHERY PERMIT APPLICATIONS AND PROJECT PROPOSALS

1. Will it make a significant contribution to the common-property fisheries? (Authority: Section 1, Chapter 111, SLA 1974). The RPT will consider and make its recommendations on each species to be produced if there is a reasonable opportunity for common property harvest consistent with the average Western Region common property fishery exploitation rate for that species. For a site to be suitable for private nonprofit development, there must be capability to generate common property harvest and at the same time provide adequate cost recovery for the facility.

Considerations pertinent to determining the potential common property benefits include:

Does the application contain significant omissions or error in assumptions? If so, the use of more accurate assumptions might indicate increased hatchery needs and decreased benefits to common property fisheries. Pertinent assumptions might include those relating to 1) interception (harvest) rates in common property fisheries, 2) harvest in the special harvest areas, and 3) survivals of green eggs to adults.

If returns cannot provide the "significant" common property benefit in the traditional fisheries, is there an adequate terminal area where new fisheries, is there an adequate terminal area where new fisheries could be created for the desired common property benefit without endangering the wild stock?

If the application provides insufficient information for adequate RPT evaluation, the team will request additional information. If they conclude that basic production and harvest assumptions are not realistic, they will recommend that changes in the proposed projects be incorporated by the applicant.

2. Does it allow for continued protection of wild stocks? (Authority: Section 1, chapter 111, SLA 1974) (AS 16.400(g) and AS 16.10.420/10). Any judgment as to the acceptability of impacts on natural stocks from an enhancement project should be make on only on the actual and potential size of the affected wild stocks, but also on the extent of benefits from enhancement and alternative enhancement opportunities in the area that may have less impact on natural stocks. Considerations include:

Can management or harvest strategies be developed to allow harvest of enhanced returns while protecting natural stocks?

Is there a segregated area for hatchery harvest that will provide adequate cost recovery without impacting wild stocks?

Does the affected stock actually or potentially support a commercial, sport, and/or subsistence fishery?

Does the affected stock have unique characteristics or are there special circumstances (e.g., a unique early run of coho)?

What is the degree of risk and the probable degree of loss to the natural stock?

3. Is the proposed project compatible with the Comprehensive Plan? (Authority: Section 1, chapter 111, SLA 1974) (AS 16.10.375, AS 16.10.400(g)). The goals and objectives of the Comprehensive Plan, Phase I, are directed toward substantial public benefits. Phase II identifies ongoing and proposed projects that are compatible with management strategies for the wild stocks. Thus, the goals and objectives of Phase I and the recommendations in Phase II provide a basis for evaluating all projects.

The project should also be compatible with management concerns and guidelines set forth in the plan and with specific recommendations concerning strategies and projects.

The RPT, in its recommendation to the commissioner, will take all of those factors into consideration in determining the project's compatibility with the comprehensive plan.

4. Does it make the most appropriate use of the site's potential? (Authority: AS 16.10.400(g), AS 16.10.430(b)). A number of very good opportunities for further enhancement programs exist in the Kodiak management area. If the plan goals and objectives, as well as substantial public benefits, are to be achieved, enhancement sites must be developed to their fullest potential with appropriate species using the best available technology.

In most instances, investigation will show one strategy to be far more effective than the others. Within a given strategy, it will be extremely important that the proposed project will develop the site appropriately and to its full potential.

Given technical feasibility, the RPT's determination of the appropriate development of a site will be based on such factors as the magnitude of its water supply, harvest potentials, manageability, and potentials to address user needs.

The applicant, in his application and presentation to the RPT, should demonstrate adequate plans for the site and the capabilities to carry them out. If the applicant does not show adequate planning and documentation, the RPT cannot judge the proposed project's ability to satisfy any criteria or determine in general whether the proposed hatchery would result in substantial public benefit as required under AS 16.10.400(g), AS 16.10.430(b), and the Mission Statement of the plan (Phase I).

An applicant should document to the RPT an ability to develop the site properly and to its full potential. This documentation should include:

Plans for implementation and full development of long- and short-term production goals and objectives; and an adequate description of facility plans for incubation and rearing.

The RPT will formulate a recommendation based on its review of the application and forward it to the commissioner within 14 days of the date when the application is considered. The RPT's recommendation should not be construed as denoting the decision to be made by the Commissioner. The ADF&G staff as well as concerned members of the public also provide reviews and recommendations to the Commissioner. The Commissioner may uphold or reject the recommendations of the RPT after reviewing all the merits and potential problems associated with the proposal.

Since the RPT need adequate review time prior to considering an application, it will generally require that applications and attendant materials be received by the RPT members at least two weeks before the meeting at which the application is to be considered. It may also request additional information during the initial review if the information in the application is inadequate. A representative from the corporation making the application will be expected to make a presentation of the proposal at the RPT meeting.

Alaska statutes specifically grant the RPT an opportunity to review a permit suspension or revocation. However, revocation by the Commissioner would occur only as a very last, unavoidable course of action. It is far more desirable to identify problems early and attempt to remedy them. Existing procedures provide for an annual evaluation of operating hatcheries. The annual report supplies information on the hatchery's past performance, while the annual management plan provides a mechanism for monitoring and modifying hatchery operations on a year-to-year basis. These documents are subject to standard departmental review. RPT review of annual reports and annual management plans is a part of ongoing planning and is also the logical extension of review of hatchery applications. Actual hatchery performance will show whether it contributes to the fishery as planned. This departmental and RPT review allows for monitoring or ongoing performance.

If the department has determined that a hatchery's performance is inadequate and that a permit suspension or revocation is being considered, the Commissioner will notify the RPT, and the RPT will be provided with an opportunity to make a recommendation on the proposed action. In evaluating any PNP operation that is referred to the RPT by the Commissioner, the RPT will use the specific performance criteria in their review, evaluation, and recommendation to the Commissioner. The criteria are established in 5 AAC 40.860 of the 1986 edition of the "Alaska Statutes and Regulations for Private Nonprofit Hatcheries." The RPT, in this evaluation, will also consider any mitigating circumstances that were beyond the control of the hatchery operator.

The reader is referred to the next section (i.e., Project Review Criteria and New Project Solicitation Form) for a detailed listing of criteria used during an initial review by the RPT of rehabilitation and enhancement projects.

In addition to the fish culture information provided in the annual report for each PNP hatchery, one additional tool is needed for evaluation of performance. The RPT recommends mandatory tagging of hatchery-released salmon of all species for at least several cycles in order to measure contributions to the fishery as well as to provide valuable information for management. This tagging must, of course, be accompanied by an adequate program for tag recovery.

Contribution to the fishery will be the ultimate measure of hatchery performance. However, it is not easy to define this criterion in measurable terms or to delineate what actions should be taken if the criterion is not met. Furthermore, the build-up of production at any facility may be slow, so that the ultimate success or failure cannot be determined for many years. As experience with hatchery operations is gained, the performance criteria should be reviewed and refined as needed. There is additional project review criteria for consideration in additoin to those listed above.

Project Review Criteria and New Project Solicitation Form

PROJECT REVIEW CRITERIA
CHIGNIK COMPREHENSIVE PLANNING

FRED PROJECT REVIEW CRITERIA

FISHERY CONCERNS:

1. Is supplemental salmon production needed and desirable?

   a. What is the socioeconomic impact on local residents and fishermen?

   b. Do the public and user groups want a hatchery in that location?

   c. Will the hatchery fulfill a substantial portion of the region's 20-year salmon goals?

SITE LOCATIONS:

1. Can the hatchery be constructed?

   a. Is the land available for reasonable purchase or lease, and will the landowners consent to construction?

   b. What is the likelihood of site and construction permit applications being approved or disapproved.

   c. Is the site area suitable and of sufficient size for hatchery construction?

   d. Will the site require special biological and/or engineering studies and surveys (i.e., land, soil, water, and organisms)?

   e. Will the hatchery be compatible with existing and future development in the area (i.e., potential habitat conflicts)?

2. Can the hatchery be operated and maintained?

   a. How accessible and logistically difficult will the hatchery be to operate (i.e., access by road, air, or sea and distance from supply point)?

   b. Protected and deep water bay for vessel docking and supply?

c. Winter access and supply problems (i.e., bay ice conditions)?

d. Is the beach suitable for amphibious aircraft and landing craft (i.e., surf and wind protection, tidal changes,beach slope, and stability)?

e. Can electrical and fueling requirements be met?

f. Can personnel (including families) and support service be provided?

g. Is the site capable of the type of hatchery (incubation and rearing systems) that would be needed?

3. Is the water supply adequate and suitable?

a. Adequate flow year around for intended operations?

b. Are water quality and seasonal temperature regimes suitable for intended operation?

c. Are exclusive water rights available, and can water quality be maintained to hatchery standards?

d. Are prime and secondary back-up water sources available?

e. Is gravity surface flow available, or will well field development and pumping be required?

f. What is the anticipated pipeline size, length, head, and route?

g. Anticipated hazards to the pipeline and intake?

h. Will future land/habitat uses conflict with quality or quantity of the water supply?

i. What is the probability of disease transmission in the water supply (i.e., virus shed by salmonids)?

4. Can brood fish be obtained and held?

a. Are local brood fish stocks available and in sufficient number at the right time?

b. Is brood fish disease history known, and are disease problems anticipated?

c. Are brood fish stocks genetically and biologically suitable and matched to hatchery water conditions (incubation and rearing schedules?

d. Can brood fish be protected from the fishery and held in estuary or other holding area for ripening?

5. Can hatchery fry production be reared?

a. Is the estuary suitable for saltwater rearing pens (i.e., protected from seas, sufficient depth, salinities, temperature, fouling organisms, etc.)?

b. Can rearing be accomplished with land-based facilities (water and facility requirements)?

6. What is the capacity of the estuary and bay for additional salmon rearing?

a. Are food organisms abundant and available at time of release?

b. Will abundance of predatory and competitor species severely limit survival of hatchery fish?

c. Are estuarine and bay conditions suitable for good fry survival?

d. Will hatchery fish displace or decrease wild salmon fry (compete and prey upon wild fry)?

7. Can adult returns of hatchery fish be readily evaluated?

a. Will returning fish be mixed with other hatchery stocks and/or wild stocks?

b. What type and quantity of evaluation effort will be required to assess hatchery operation and goal achievement?

<u>FEASIBILITY CONCERNS</u>:

Is the hatchery feasible?

1. Are cost/benefit ratios and Net Present Value (NPV) acceptable and justifiable?

2. Are there specific or special economic impacts, benefits, and costs involved?

3. If constructed, will the hatchery distract from other worthwhile or perhaps more feasible projects and facilities for the region?

CRITERIA FOR FISHPASSES

FISHERY CONCERNS:

Same as for hatcheries with the frequent addition of increased need for regulation enforcement in remote areas as a salmon run is increased and additional escapement is required.

SITE CONCERNS:

1. Can the fish pass be constructed?

   Same as for hatcheries with additional engineering requirements on high and low water flows and velocity, rock competence and fracture zones (geomorphology), fishpass location (protection) and salmon entrance, and passage capability. Each site requires specialized studies to determine the best engineering design for a specific location and target species.

2. Can the fish pass be operated and maintained?

   Many of the same criteria as for hatcheries, especially during the construction stage, but less restrictive and demanding once built.

   Fish passes require only seasonal operation and maintenance before, during, and after salmon migration. Larger fishpasses with salmon diversion weirs and manual water control structures require manned operation. Smaller installations require only opening, maintenance, spot-checking operation, and end-of-season closure.

   Manned facilities require construction, operation, and maintenance of field living quarters, equipment, and seasonal logistical support of personnel.

3. Is the water supply adequate and suitable?

   Many of the same water quantity and quality concerns for hatcheries are also important for fishpasses. Fishpasses require adequate flow for efficient salmon attraction and passage. Salmon are attracted to the area of greatest flow. Falls close to a fishpass entrance will tend to attract salmon to the falls rather than the fishpass unless diversion weirs are operated.

High water flows are of more concern for fishpasses than most hatcheries. Fishpasses can be flooded-out by high flows or permanently damaged by debris and ice during floods. Weirs and other associated fishpass structures have a high risk of wash-out and damage by debris at a falls.

Low water flows require either self-controlling or manual water control diversion to the fishpass.

4. Will wild salmon naturally use the fishpass and establish upstream spawning?

   Some systems and stocks will require a hatchery and fry or egg transplants to establish new spawning area. Brood-stocks, therefore, become a consideration for fishpasses, as well as for hatcheries.

   Natural stock below the falls may be sufficient to extend spawning range and use the fishpass without assistance. Stocks that are genetically programmed to spawn downstream or in site-specific areas (i.e., intertidal pink salmon, chum salmon that spawn in spring areas, etc.) may be slow to use a fishpass or may not extend spawning range.

   Increased escapements are usually necessary to increase salmon density below the fishpass and, in turn, increase range extension upstream and salmon passage. Salmon passage through a fishpass is to some extent density related.

5. Is the upstream spawning and rearing area adequate?

   The quality and quantity of spawning and rearing area above the falls area needs to be assessed to determine potential production capability. Biological evaluation of egg-to-fry survival may be required as part of this assessment.

6. Will emigrant fry or smolts survive to reach salt water?

   Fry and/or smolt survival at falls requires assessment. Substantial mortality might occur at high vertical drop-offs on underlying rock. A series of falls may have greater mortality risk than a single fall.

7. What is the capacity of the estuary and bay for additional salmon rearing?

   Same considerations as for hatchery fish releases.

8. Can adult returns of fish produced by a fish pass project be readily evaluated?

Both escapement and catch assessment is required. Counts at the fishpass and on spawning areas, in addition to commercial catch information, are a minimum evaluation effort. Frequently, mark and recovery projects are needed. Evaluation concerns for fishpasses are the same as for hatcheries. Additional evaluation to improve fishpass effectiveness and salmon passage is often required.

<u>FEASIBILITY CONCERNS</u>:

1. Is the fishpass feasible?

   Same as for hatcheries. Normally, benefits are high for dollars spent on fishpasses, but the return on investment is usually more limited than for a hatchery and may also take longer to realize.

SPORT FISH PROJECT REVIEW CRITERIA

1. Fishery Status
   - Is it a depressed fishery?
   - Has the fish population been decimated or eliminated?

2. Habitat Assessment
   - Lakes should be five acres in size or large, at least eight feet deep.
   - Predator/competitor concerns must be identified.
   - Available spawning area should be identified/estimated.
   - Water quality characteristics.
     - D.O., Temp., Alkalinity, Conductivity
     - Morphodaphic Index-richer lakes are stocked prior to poorer lakes.

3. Access
   - Will it create new fisheries (has to have the potential)?
   - Accessible to the fishing public, anything you can hike to from the Kodiak road system within two hours would be a priority over fly-in.

4. Effect on Management
   - New sport fish projects should not complicate commercial fisheries management plans.

5. Lake Stocking Guidelines
   - ADF&G guidelines should be adhered to with any new projects.

6. Genetics Consideration
   - Donor stocks would have to be taken from as close to the area as possible.

COMMERCIAL FISHERIES PROJECT REVIEW CRITERIA

Regarding supplemental production (enhancement):

1. What are the potential effects on management plans with the placement of a hatchery?

2. What effects will the proposed production, by species, have on present management schemes?

3. What effects will the hatchery stocks (and their harvest) have on natural stocks in the area?

4. Can returns be harvested to provide "significant" common property benefits in traditional fisheries?

5. Is there an adequate terminal area where new fisheries could be created to affect the desired common property benefit?

6. Does the hatchery as proposed allow for the continued protection of natural stocks?

   a. Can management or harvest strategies be developed to allow harvest or enhanced returns while protecting natural stocks?

   b. Is there a segregated area for hatchery harvest that will provide adequate cost recovery without impacting wild stocks?

   c. Does the affected wild stock actually or potentially support a commercial, sport, and/or subsistence fishery?

   d. Does the affected stock have unique characteristics or are there special circumstances (e.g., an unique early run of coho)?

   e. What is the degree of risk and the probable degree of loss to the natural stocks?

7. Does the hatchery proposal make the most appropriate use of the site's potential?

Ref./File#: ________
Date: ______________

CHIGNIK REGIONAL PLANNING TEAM
FISHERIES REHABILITATION AND/OR ENHANCEMENT
NEW PROJECT SOLICITATION FORM

This form is to be used by Fish and Game and other government agency personnel and the public to identify opportunities that may be worthy to pursue to help rehabilitate and/or enhance the fisheries.

PROJECT DESCRIPTION:

1. WHAT: (Give a brief description of the project):

2. WHERE (be specific as to project location):

3. BENEFITS TO USER GROUPS:

4. COST ESTIMATE OF PROJECT (IF KNOWN):

5. SUBMITTED BY:

Name: ______________________ Date: ______________

Address: ____________________ Phone: _____________

______________________________ Occupation: ________

6. ADF&G COMMENTS:

7. COMMERCIAL FISH MANAGEMENT COMMENTS:

8. SPORT FISH MANAGEMENT COMMENTS:

9. HABITAT PROTECTION COMMENTS:

10. FRED MANAGEMENT COMMENTS:

11. REMARKS:

Ref./File #: _______
Date: _______________

POTENTIAL PROJECT VERIFICATION FORM

NAME: ______________________________ Date: ______________

LATITUDE: ___________________________ SURVEYED BY: ___________

LONGITUDE: ____

GEODETIC MAP NO: ____

LOCATION: ____

AERIAL SURVEY

NOTES: ____

____

TRAILS: ____

____

PROJECT WILL PRIMARILY BENEFIT: ___________________________

____

AVAILABLE ESCAPEMENT DATA:

Year	Pink	Chum	Coho	Sockeye	King	Steelhead

Other Species Present: ___________________________________

____

____

Elements of the Benefit/Cost Analysis

Steps for undertaking the projects identified in this plan will incorporate variables such as the facilities and equipment, cost of operations, and the financing.

Feasibility of a Project

In determining the feasibility of a project, the team may consider the four following questions:

1. Are benefit/cost ratios and Net Present Value acceptable?

2. What special economic impacts, benefits, and costs are involved?

3. If a hatchery or other facility is constructed, will it detract from other more worthwhile projects in the region?

4. Will the cost for an annual hatchery or other facility operation and maintenance decrease funding available for other projects in the region?

Costing a Project

The cost of a project can generally be segregated into three major categories, depending upon the nature and the scope of the task. These are as follows:

Facility and Equipment:

- Site section, including studies of alternative areas.
- Site acquisition.
- Construction costs, including planning fees.
- Equipment acquisition.

Operations:

- Cost of labor, utilities, fish feed, personnel, and maintenance costs.
- Administrative.
- Project evaluation costs.

Financing:

- Available funding sources.

- Current interest rates.

Economic benefits to most groups directly affected by specific projects are easier to identify. However, the benefits of an enhanced fishery to sport and personal use fishermen are, again, very subjective and therefore difficult to assign a dollar value. The dollar impact to this group may not vary significantly from project to project and, when compared to the total economic benefit/cost ratio, will not have a significant effect on the overall analysis.

Economic Benefits to Commercial Fishermen and Processors

The economic benefits to these two groups can be expressed in dollar terms throughout the analysis of two major components; the anticipated increase product available for catch and the dollar value of the catch increase. Regardless of the nature of the project, however, the amount of product available depends on the annual adult salmon rate of return and the annual catch rate, expressed in terms of pounds of product.

Variables to Consider in Determining the Product Value

The value of the caught product includes a scrutiny of the following variables:

1. Type of product;

2. Anticipated market price, including the effect of world supply and demand on the market price; and

3. Cost of catching and processing the product.

In order to prepare a benefit/cost analysis for hatchery stock development, a form is available from ADF&G which provides in detail the variables required to determine the quantity of catchable product, value of the catch, impact multipliers, and cost information relating the development of fish hatcheries. For further information, contact ADF&G, FRED Division in Kodiak.

APPENDIX B

SUMMARY OF RESULTS (33 RESPONDENTS) OF THE AREA L (CHIGNIK) QUESTIONNAIRE FOR COMPREHENSIVE SALMON PLANNING:

1. Check the category that describes your salmon fishing activities in the Chignik region in 1990: (a) commercially fished for salmon, (b) did not fish commercially, (c) subsistence fished for salmon, (d) did not subsistence fish.

All 33 respondents commercially fished for salmon--13 of them noting that they also subsistence fished for salmon.

2. What percentage of your annual gross income comes from the following sources? (a) salmon seining in Chignik region, (b) other fisheries in region, (c) fisheries in other areas, & (d) nonfishery sources.

Thirty-one responded. Only 3 fishermen indicated percentages less than 80% derived from Chignik fisheries; i.e., two of them relied on fisheries in other areas for the remaining gross, while only the remaining one received the majority (i.e., 60%) of his income from nonfishery sources. Of the 28 fishermen reporting the bulk of their income from salmon seining in the Chignik region, the average contribution was 95.3%, with the remainder evenly distributed among the three other categories.

3A. Are you satisfied with the above breakdown?

Twenty-five indicated they were satisfied, five were not satisfied, and three failed to respond.

3B. If not satisfied, what would you like to see changed?

Of the five indicating dissatisfaction, three responded: (#12) limited entry for cod and other fisheries to be regulated by region; (#13) realize more earnings from the other fisheries in the region; and (#19) need to construct a hatchery.

4. Are you satisfied with your earnings from commercial salmon fishing in the Chignik region, yes or no?

There was an even split between the 30 respondents: 15 satisfied and 15 dissatisfied.

5. If you are paying for your permit, are your earnings adequate to cover the cost?

Fourteen failed to respond, four said they were adequate, six said they were inadequate, and nine said the questions was nonapplicable.

6. What do you need to gross from all sources in an average year to pay for your fishing and living expenses?

Six failed to respond; responses from the remainder follow:

$ 50,000--2	$200,000--3	$400,000--3
$140,000--1	$250,000--4	$450,000--1
$170,000--1	$300,000--5	$500,000--2
$175.000--2	$350,000--2	$600,000--1

Discounting the high and low gross incomes, the average is approximately $300,000.

7. Do you own a licensed commercial fishing boat?

Thirty (91%) responded affirmatively, and three said no.

8. Is your boat financed?

Twenty said yes (61%), nine said no, and four said the question was nonapplicable.

9. What is the total investment you have in your permit, boat, and gear for the salmon fishery?

Two failed to respond. Of the three individuals stating they did not own a boat, #2's investment was zero, #3's investment was $600,000, and #27's was $40,000. Investments ranged from $180,000 to $1.5 million for the remaining 28 respondents. Discounting the respondent with no investment, the average for the remaining 32 is $745,400.

$180,000--1	$650,000--4	$850,000--1	$1.05 million--1
$200,000--1	$700,000--1	$875,000--1	$1.2 million--2
$300,000--1	$750,000--3	$900,000--2	$1.3 million--1
$500,000--2	$766,000--1	$950,000--1	$1.5 million--1
$600,000--2	$800,000--1	$1.0 million--1	

10. In which of the following fisheries do you participate?

(a) salmon--33, (b) king crab--1, (c) Tanner crab--3, (d) Dungeness crab--1, (e) halibut--17, (f) herring--12, (g) cod--8, and (h) other--1.

11. What species of salmon would you like to see increased (Choices to be ranked 1-5, with No. 1 the most important)?

Sockeyes were unanimously ranked No. 1 (31 of 33 respondents);cohos were ranked No. 2; chums, No. 3; kings, No. 4; and pinks No. 5.

12. Do you take a portion of your catch home for personal use?

Twenty-four responded affirmatively, seven said no, and two failed to respond.

13. Which species of salmon do you prefer for personal use?

Most responses were multiple, and 2 fishermen failed to respond. Sockeye was decisively the preferable species with 24 votes, kings ranked second with 10 votes, cohos third with six, and pinks and chums in the fourth and fifth positions with 2 and 1 vote, respectively.

14. How many of the following species (i.e., sockeye, coho, pink, chum, king) did you take home for personal use?

Of all respondents three said none, and eleven failed to specify numbers or species. Nineteen respondents reported taking approximately 1,140 sockeys, 410 cohos, 215 pinks, 85 chums, and 85 kings.

15. In which districts do you prefer to fish?

Responses were invariably multiple, indicating similar preferences for the Central, Lagoon, and Westward districts (i.e., average of 20) as well as those favoring the Eastern and Perryville districts (i.e., 13 each):

(a) Eastern--13, (b) Central--20, (c) Chignik Bay (the lagoon)--22, (d) Westward--19, and (e) Perryville--13.

16. In which districts would you like to see salmon stocks increased, ranking your choices from 1 to 5, with 1 representing the most important district?

Thirty fishermen responded to the question, although not all completed it as requested by ranking the areas. All but two indicated Chignik Bay as the principle area for increasing salmon stocks (i.e., sockeyes). The Central district ranked second; Westward, third; Eastern, fourth; and Perryville, last.

17. What are the most important problems with commercial fisheries in the Chignik region, ranking your choices from 1 to 7, with 1 representing the most important selection?

The respondents ranked the problems as follows:

(1) price/markets, (2) lack of fish, (3) overcrowding,
(4) management, (5) habitat protection, (6) regulations, and
(7) enforcement.

18. Should the Chignik Regional Aquaculture Association consider a sockeye salmon hatchery if a location can be found where reasonable segregation from natural stocks could be accomplished?

Eleven said yes, five said no, and 17 said possibly.

19. What are your concerns when considering a hatchery, ranking 1 to 5 with 1 representing the greatest concern; i.e., (a) virus, (b) harm to natural stocks, (c) too expensive, (d) problems can be overcome, and (e) unmentioned concern?

An overwhelming majority indicated that harm to the natural stocks was the greatest concern. The other concerns ranked as follows:
(2) virus, (3) too expensive, (4) problems to be overcome, and (5) unspecified.

20. Please rank the following project possibilities in terms of importance, with 1 representing the most important factor.

The ranked project possiblities follow: (1) raise/stabilize the level of Black Lake to maintain the rearing environment; (2) divert Alec River to maintain the rearing environment in Black Lake; (3) conduct studies to evaluate the production/carrying capacity of Chignik and Black Lakes; (4) conduct studies to determine whether and where lake fertilization projects could be beneficial; (5) place sonar counter on the Chignik River to gain more information about sockeye and coho salmon escapements; (6) clear logs and boulders in pink and chum slamon streams where there is blockage; (7) initiate salmon hatchery site investigations to identify locations for this type of enhancement; (8) implement small-scale enhancement and rehabilitation projects such as in-stream egg incubation boxes; (9) initiate tagging studies to determine sockeye salmon origins in the Shumagin Islands and the Westward/Perryville management districts; (10) conduct studies to determine appropriate candidates for lake stocking projects; and (11) other projects (please describe).

Two respondents considered cleaning out beaver dams in Black and Chignik Lakes as the number-1 priority for projects. The ranking of the 1st four projects by respondents was clearly defined. Although the ranking was less defined and widely varied for the remaining projects, the ranking presented here fairly well represents that of the respondents.